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THE PARIS CATASTROPHE.

The terrible disaster at Les Couronnes Station of the Paris underground should serve as an awful warning to the management of similar systems. The Liverpool accident a year and a half ago was bad enough, but the present instance is far worse both in its results and in the causes which led to them. Each resulted from a train taking fire, but at Les Couronnes the burning trains were empty and the loss of life resulted from the smoke overwhelming the passengers of a following train, caught like rats in a trap and suffocated because they could not get out of the station, which served as a chimney for the burning trains. There is nothing new in a train, either steam or electric, catching fire through some accident in a tunnel or out of it, and until more care is exercised in encouraging fire-proof construction, trains will now and then be inflamed. But there is no need of loss of life even in such cases unless a collision has lent its fatal aid. We do not think that as a matter of experience, electric trains run more risk of fire than others, and in the present instance the train which furnished the victims was uninjured. The grim list of the dead cannot be charged up to electric driving nor to the intrinsic dangers of underground roads. From all the information which has reached us, it stands to the account of those who planned stations without sufficient means of exit. It has no more connection with the train service as such than a holocaust in a metropolitan theatre would have to the chance cause that might start the flame. There are very few theatres in which a fire once under way would not cause great loss of life simply from insufficient means of exit. The original source of the fire might or might not be due to negligence, but the arrangements which would block escape would certainly throw a great responsibility on the managers.

After the Liverpool disaster, Mr. Westinghouse raised a very pertinent discussion as to the dangers which might arise, but we thought then and think now that the danger lies not in electric driving nor any form of it, but in insufficient precautions against the results of a fire once started. Mr. Westinghouse's contention in favor of non-combustible cars is in itself sound, but it is fundamental and applies with equal force whatever may be the assumed cause of the fire. We do not yet know what, if any, were the precautions adopted in Paris, but in many, we think in most, instances American electricians have their electrical equipment so installed that the danger of fire from it is remote. But granting that an underground train may from some cause take fire, the all-important question is the ready escape of the passengers to a place of safety. Entirely non-combustible cars are by no means easy to construct, but accidents like that at Les Couronnes should teach the lesson that Manila Bay and Santiago taught the world's navies. Whatever steps may be taken in this direction, however, the means of escape from the dangerous confinement of a tunnel ought to receive the most careful attention. In particular, the tunnel should be as well lighted and ventilated as possible, and the exits to the street from stations should be ample to serve even in case of panic. Gates and turnstiles are everywhere, as they were at Les Couronnes, a source of danger. They are quite needless obstacles if there is proper attendance, and if present in any form, should be such as would immediately yield in case of necessity. In case of a panic ordinary turnstiles and sliding gates are very easily jammed and are quite certain to lead to loss of life. In a station filled with smoke, exit is none too easy even if the way is clear, and in the Paris catastrophe it looks very much as

though the attendants lost their heads, as well as the passengers from the fatal train. Where the third rail is the source of power, an additional menace exists which the progress in guarded rail construction ought to render impossible in the near future. Looked at from any aspect you please, an unguarded third rail is a dangerous thing for any one compelled to court its acquaintance; and in case of a tunnel accident the chance for fatal results in the ensuing panic would be unpleasantly great.

But in spite of the terrible results of the Paris affair, we are convinced that similar potential conditions for disaster do not exist in our American practice. For one thing the underground lines, built and projected here, are planned with particular regard to good lighting and ventilation. They are, too, far more roomy than many of the foreign "tubes," and are fairly near the surface and provided with numerous stations. With the extra space comes less danger of dense smoke and far more room for escape in case of necessity. The provisions for ventilation are good, and it is hard to imagine any conditions under which a dangerous amount of smoke could accumulate. With attention to the matter of easy exits, it is difficult to see how even in the panic of a sudden fire the dreadful results of Les Couronnes could be paralleled. It must be remembered, however, that the chance of successfully fighting a fire once started on a train of ordinary construction is very small, and the only thing to be done is to get the passengers out as quickly as possible and to a place of safety. Precautions should be directed especially at prevention by making the material within reach of the electrical equipment as nearly fire-proof as possible. Whether it is advisable to attempt fire-proofing the car as a whole is open to some question; but it certainly should be possible to adopt a construction which would prevent the rapid burning that is the cause of a dangerous amount of smoke which is in such cases, as indeed in most fires, the principal peril to life. With proper protection of the electrical apparatus and circuits it should be practically impossible for a train to be set on fire unless as the result of a collision; and collisions with the block systems now in use or available should be quite out of the question. The real source of danger in the modern rapid transit systems is not the motive power adopted nor the manner of its application, so much as the severity of modern requirements as to speed and headway. Every year sees a more and more pressing demand for frequent trains, quickened acceleration and higher schedule speed. To meet these requirements precaution should grow with the service, and we are glad to say that on American systems such is generally the case.

LIGHTING AND TRACTION.

We have already given the details of the United States Census figures of electric lighting stations in this country, and have called attention to certain facts in regard to them. There are so many points of interest in these official and first authentic figures, it will take some time to digest and comprehend them. It may be noted primarily that in power plant capacity the lighting and trolley industries are very much on a par. The street railways have just about 1,300,000 horse-power in engine and water wheel capacity. The lighting plants have just about 1,750,000 horse-power. The output for the street railways was returned at 6,249,910 kilowatt-hours per day, or 2,261,484,397 for the year. The lighting plants report an output of almost the same figure, namely, 2,437,218,732 kilowatt-hours for the year, or 6,677,310 per day; so that while the output of the lighting plants is half a million kilowatts larger daily, the plants run fewer hours. This is quite in accordance with observation. The dynamo capacity of the railways is 1,204,238 horse-power, while the dynamo capacity of the lighting plants is 1,615,480 horse-power. Reducing this to kilowatts, it would appear that the capacity of the railways is in full use nearly eight hours daily, while the capacity of the lighting plants is in use about six hours daily.

After all, this is a rather surprising result, for a street railway system is understood to be in operation pretty well all around the clock, while lighting is necessarily limited to a few hours. On the other hand, the development of day circuits for power purposes has come in of late years to increase hugely the output of the lighting plants, while it is obvious that there must be many trolley systems that taken the year through would not average as many hours of operation as a busy lighting plant. In each case the controlling, economic idea must be to increase the number of hours of operation, for upon that item depends capitalization and return in dividends.

A QUESTION OF SCIENTIFIC PRIORITY.

Elsewhere we print an article by Brother Potamian, the distinguished authority on early electrical literature, in which he examines into the question of priority with respect to the experiment proving that the charge of an electrified body resides on the exterior surface. French writers as a rule assign credit for this experiment to Biot—at least by implication through designating the experimental apparatus by his name. Maxwell has claimed the honor for Cavendish, and others have assigned it to Coulomb. It is shown that the experiment was first performed in 1773 by Cavendish, and that the paper of Coulomb describing a similar experiment appeared in 1788. It also appears that while Biot never personally claimed credit for the demonstration, he refrained from stating in his writings that his knowledge on the specific subject was derived directly from the work of Coulomb. All of the benefit which the world has derived from the establishment of the great principle involved has, however, come from the publicity given to his work by Coulomb, the particulars and results of the Cavendish experiment not having been made public until 90 years after the publication by the former. Thus, so far as concerns scientific progress there is no debt of gratitude owing to Cavendish—that eccentric scion of a noble family who seemed to view mankind in general with no little of the contempt which he bestowed on woman in particular, and who pursued scientific investigations apparently solely for his own selfish gratification.

The settlement of this interesting question of priority directs attention to the great value for purposes of historical scientific research of the Wheeler Collection in the Library of the American Institute of Electrical Engineers. The preparation of a bibliography of this great collection is in the admirably competent charge of Brother Potamian, and when published the notes accompanying each title will be invaluable in facilitating research. Another great work in connection with the Institute Library remains, however, to be provided for, and that is the preparation of keys to the electrical and cognate papers in the great *Transactions* of scientific bodies which up to about a generation ago were almost the sole repositories of scientific knowledge in original form. During the past two years many complete sets of such *Transactions* have been placed on the shelves of the Library through the generosity of friends of the Institute. At present the Institute Library is probably richer than any other library in the United States in this extremely important branch of scientific literature, and the plans of the Library Committee contemplate making the collection practically inclusive of everything of value in this line. In the absence of keys to the contents, such a collection has, however, little value to those who cannot spare time for extended research, and the vast extent of the material is appalling even to the most enthusiastic delver in original sources of knowledge. Such a collection of keys as proposed would, moreover, be invaluable to every scientific and large public library of the world,

and its preparation and publication by the Institute would attach to that body a permanent and world-wide prestige. The proceeds of an endowment fund initially for this purpose could, after the completion of the keys—the preparation of which would be a labor of years—be utilized as a publication fund for other purposes, notably in the compilation and printing of a monthly index of current electrical and physical literature, in connection with a system whereby members by forwarding coupons could obtain in the shortest possible time periodicals containing articles noted which interested them. It is to be hoped that some day the Institute shall be made by the gift of some friend the custodian of a fund for the accomplishment to perpetuity of such worthy objects.

THE LEGALIZED STANDARD OF ELECTROMOTIVE FORCE.

Prof. Carhart's paper on this subject, recently read before the American Institute of Electrical Engineers, points to the advisability of changing our devotion from the zinc-mercury cell of Clark, to the zinc-cadmium cell of Weston. Ever since the days of Volta, a voltaic cell has furnished the recognized concrete standard of electromotive force. The earlier forms of voltaic cell were subject to considerable variation in e.m.f., owing to polarization. The old Smee cells of zinc and copper in acidulated water, had an e.m.f. anywhere between 0.7 and 1.1 volts, depending upon the current-strength supplied, and upon the previous history. The Daniell cell, with its porous partition and copper-sulphate depolarizer, brought about a marked advance in the uniformity of voltaic standards. The e.m.f. of this cell ranged between 1.0 and 1.15 volts, according to polarization, concentrations and temperature. For years standard Daniell cells were employed in electrical laboratories. The solutions were prepared with care to definite concentrations, and the plates were freshly cleansed before use. The best results which could be obtained in this way varied within a range of one per cent. At length the standard zinc-mercury cell of Latimer Clark was produced. It was made from chemical substances that could be obtained and prepared with a relatively high degree of purity. It was remarkably constant and had a relatively small temperature-coefficient of e.m.f. This cell became a universal favorite as a concrete standard. A number of researches were conducted in electrical laboratories to determine the actual e.m.f. of the Clark cell. These standardizing measurements usually involved either an absolute determination of e.m.f. generated electromagnetically, and compared with the Clark cell; or, an absolute determination of a current strength, and a comparison of the drop of pressure effected by this current through a known resistance, with the Clark cell. The original standardization of the British Association Committee, when the ohm was first produced in concrete form, depended mainly on the first-mentioned method, and a small standard dynamo was constructed in such a manner that the e.m.f. of this dynamo at a measured speed could be computed. Nevertheless, the first set of measurements adopted produced ohms that were more than one per cent. too small, and the "B. A. ohms" first promulgated had to be corrected by years of observation and recomputation, first by about one per cent., to "legal ohms," and more recently by about one-tenth of one per cent., to "international ohms," the present universally accepted concrete standard.

The Chicago Electrical Congress of 1893, which adopted the international ohm, also adopted the Clark cell as the concrete standard of e.m.f., and assigned to it a conventional value of 1.434 international volts at 15° C. Prof. Carhart points out that it is practically certain that the true value of the Clark cell's e.m.f. at 15° C. is nearer 1.433 than 1.434. This represents a degree of uncertainty in our fundamental concrete standard of e.m.f. of about 0.07 per cent., or nearly one-fourteenth of one per cent.; whereas, two steady e.m.f's, in the neighborhood of one volt, can be compared numerically without much difficulty to a degree of accuracy of one-hundredth of one per cent., while a numerical comparison of correspondingly less reliability can be made down between them to say one-thousandth of one per cent. This degree of uncertainty residual in the Clark concrete standard of e.m.f. is by no means so trivial a matter as might at first sight appear. There is hardly any branch of electrical engineering in which as great a degree of accuracy is required for commercial measurements as in voltages near 100 volts. This is owing to the sensitiveness of incandescent lamps to the pressure at their terminals. A sixteen candle-power lamp of ordinary efficiency will vary in luminous intensity by about one candle with a change of one volt in say 116. Commercial measurements of candle-power and candle-power-time are sensitive to errors of one-tenth of a volt in 116. Consequently, the contract conditions under which incandescent lamps are made and sold, involve a degree of accuracy in voltage standards of nearly the same magnitude as the degree of residual uncertainty in the e.m.f. of the Clark cell.

It has been shown within recent years that the zinc-cadmium, zinc-sulphate, cadmium-sulphate cell is superior to the Clark cell as a standard of e.m.f., especially when made with supersaturated cadmium-sulphate solution. With under-saturated solutions, the cell is known as the Weston standard cell. The e.m.f. of this cell, in its most carefully prepared form, is only about 2 per cent. greater than the international volt, and its temperature-coefficient of e.m.f. in the neighborhood of 20° C., according to Prof. Carhart, is only about the 1/250th of one per cent. per degree Centigrade. These conditions render the cell specially well adapted for an international concrete standard. In view of the fact that the Clark cell has a much larger temperature-coefficient, and also that it has been hitherto impossible to arrive at uniformity of opinion as to the specifications under which the Clark cell should be prepared, it seems desirable that the cadmium cell should be generally adopted as the international concrete standard, assuming that there would be no difficulty in the patent situation. It is stated in the paper that the e.m.f. of the Clark cell at 15° C. is 1.40670 times greater than that of the cadmium cell at 20° C. This makes the e.m.f. of the cadmium cell 1.0187 volts, if the e.m.f. of the Clark cell be 1.433 volts at the specified temperatures.

The paper intimates that a redetermination is soon to be attempted of the e.m.f. of the cadmium cell by means of an absolute measurement of current strength, and with a revised form of electrodynamometer. A suitable steady current is passed through such an instrument, in series with a known resistance, the drop in which is balanced against a cadmium cell or battery. The electromagnetic force of the current is balanced by a measured amount of torsional force. The strength of the current may then be computed from the torsion and the geometrical constants of the apparatus. The main difficulty with such an instrument for very accurate measurements lies in the uncertainty of the principal dimensions of the coils, owing to shrinkage or deformity under the stresses originally applied in winding. In the new apparatus described, the external coil is wound on a hollow cylinder of plaster of Paris; while the internal coil is wound on a smaller cylinder of ground porcelain. The stability and homogeneity of these materials are relied upon to maintain the accuracy of geometrical form. With our concrete resistance standards reliable to 1/50th of one per cent., and concrete cadmium cells standards of e.m.f., reliable also to 1/50th of one per cent., the international ampere would be independently reproducible from the volt and ohm, to 1/35th of one per cent.

The Safety of Underground Electric Travel.

The terrible accident in the tunnel of the Paris Metropolitan Railway, noted in these pages last week, has naturally evoked endless comment and suggestion. It is reported from Paris that M. Vignes, the manager of the Metropolitan Railway, states that the catastrophe was due entirely to the neglect of Chauvin, the motorman of train No. 43, to observe the rule that when a motor becomes short-circuited the motorman must isolate it from the remainder of the train and continue the run with another motor. Instead of doing this, Chauvin used hand grenades. Believing that he had extinguished the flames, Chauvin continued the trip with the damaged motor. The train, after leaving Barbes, crossed a viaduct, and the open air must have revived the fire. Chauvin refuses to be made a scapegoat. He says that it is impossible to isolate the motor from the rest of the train. Moreover, he had, earlier in the day, pointed out defects in the motor, which had been in the shops a half hour for temporary repairs.

At a special meeting of the Paris Municipal Council several of the members condemned the management of the Metropolitan Electric Railway, particularly in regard to a motion passed eight months ago inviting the company to improve the ventilation of its tunnel. The company will be asked to adopt a system for lighting its carriages and stations, which will not be connected with the electric rails. It will also be asked to provide oil lamps, to be kept constantly lighted, to increase the number of sidings, and to use fire-proofed hardwood in the construction of its carriages instead of pitch pine.

August Belmont, president of the Interborough Rapid Transit Company, of New York City, declared that there was no possibility of such an accident as that in Paris occurring in the New York Subway. "I want to emphasize the fact that the tunnel in Paris is not well ventilated," he said, "while in the New York Subway methods have been adopted to insure the free circulation of air. Both on account of the better circulation and the fact that part of the New York system is an elevated structure and trains run in from, and out to, the open air, there will be a syphoning of air in the tunnel by moving trains which will make the conditions here far better than in the Paris subway, which is all underground. Besides this, the entrances and exits of the New York Subway stations are open. Those of Paris are provided with self-closing doors. I also want to emphasize one of the most important features of the New York Subway. The system here has an independent lighting plant provided. One plant generates current for power and another plant current for lighting the Subway and stations. In Paris the lights in the tunnel went out, and this added greatly to the loss of life. In our system, whatever may occur in the tunnel, it is so arranged that it shall be perpetually lighted by a perfectly independent plant and current throughout the entire tunnel and all stations.

The *Daily Mail*, of London, prints an interview with Charles T. Yerkes, who is building underground tramways in London, on the subject of the Paris disaster. He says that four-fifths of the engineers, consulting or otherwise, connected with electric transit in London, are without practical knowledge. The case is the same in the United States, although the engineers there have more practical experience than those in London. Mr. Yerkes thinks that disaster is always possible, unless all inflammable material is removed entirely from electric railways. The managers of the local underground railways of London have issued statements with a view to assuring the public that such an accident as occurred on the Paris road would be impossible on their systems.

In an interview on the subject, Mr. E. P. Bryan, vice-president of the New York Interborough Rapid Transit Company, said: "Such an accident as that in Paris would, I firmly believe, be absolutely impossible in the Subway here. It is hard to understand how things could be quite so bad even in Paris, if the officials and people had not got so excited. I do not want to criticise, but the cars over there, at least when I was there, were light wooden affairs, and there was a good deal of woodwork, carved and otherwise. Besides, the people were crowded in in a manner far worse than you ever saw on the elevated. The ventilation was poor, and there was an awful smell of creosote, which both William Barclay Parsons and myself remarked. This creosote was used on the wooden ties to make them waterproof, and I believe that these ties helped to make the smoke and fire. Here we will use wooden ties, but they will be covered with broken rock and the ballast used on the same principle as the roadbed of the Pennsylvania Railroad.

"Then, too, our cars will weigh 68,000 pounds, will be of asbestos and transite on the flooring, while the sides, from the floors to the windows, will be of copper sheeting. The insulation will be carefully carried out by our own men, who will be kept well in hand. Defective wires make fires, and this fact we never have lost sight of. If our cars are not absolutely fire-proof they are at least of slow combustion. Then, too, we have the provision for shutting off current in the event of accidents, and emergency shut-offs will be situated at every station. I think the chances of accident are reduced to a minimum when we have improved so much over the elevated system, and when it is remembered that not a single person has ever been killed while riding as a passenger on the Manhattan Elevated in spite of the fact that 4,000,000,000,000 people have been carried. The only deaths have been caused by people jumping against closed gates and in other ways through their own fault. In addition to all this, we have an absolute block system for express trains, so there never can be two trains on a block."

Engineer Thompson, who is in charge of the rolling stock, told of the car construction at the request of Mr. Bryan. "The first flooring is of maple, because that is the wood slowest to burn, and does not carry flame. This is the bottom on the sills, and on top is a layer of one-eighth-inch roll of fine felt, an asbestos product. Then comes another floor of maple, and before any of the sheeting below the floor is laid all the timbers and the sides are covered a quarter of an inch thick with asbestos transite board. In addition we have four sheets of quarter-inch steel above the motor, and the motor wires and control wires of 550 volts capacity are all laid in electro-asbestos conduits and fastened to the lower sides of the floors with screws. On each cable are layers of asbestos insulation, and every point of contact is absolutely protected."

The fact is recalled by several New York newspapers that in January, 1902, Mr. George Westinghouse issued a letter in which he warned the public against the serious dangers of electric cars that are not fire-proof. The daily papers have also had an abundance of letters and interviews on the subject, which has assumed further importance from the fact that not only on the tunnel systems of New York City, but on the new tunnels between Manhattan Island and the New Jersey and Long Island shores, electric traction is to be employed; while the tunnels will be long without any intermediate exits.

Edison Association Programme.

As previously announced, the twenty-fourth convention (nineteenth annual meeting) of the Association of Edison Illuminating Companies will be held at The Frontenac, Thousand Islands, St. Lawrence River, New York, commencing Tuesday, September 8, 1903, at 9.30 A. M. Indications promise a most successful convention from every point of view. We give below a list of the papers prepared to be read: "Commercial Experience with Nernst and Meridian Lamps," by Mr. W. B. Thompson, Detroit, Mich.; "Purchased Electric Power in Factories," by Mr. E. W. Lloyd, Chicago, Ill.; "Operating Features of High Tension Power Stations," by Mr. W. F. Wells, New York, N. Y.; "Position of Steam Turbines in Central Station Operation," by Mr. August Kreusi, Schenectady, N. Y.; "Overhead Pole Line Construction and Operation," by Messrs. A. H. Manwaring and J. T. Hutchings, Philadelphia, Penn.; "Comparison of European and American Engineering Practice," by Mr. Charles Schwartz, Chicago, Ill.; "Profitable Advertising," by Mr. W. H. Johnson, Philadelphia, Penn.; "The Central Station and the Isolated Plant," by Mr. Douglass Burnett, New York, N. Y.; "Depreciation in Electric Light Plants; How Estimated and Applied," by Mr. H. M. Edwards, New York, N. Y.; "Selection and Installation of High-Tension Switching Apparatus," by Mr. Leonard L. Elden, Boston, Mass.; "Illumination," by Mr. C. P. Steinmetz, Schenectady, N. Y.; "Results Obtained with Steam Turbines in Milan, Italy," by Mr. Guido Semenza, Milan, Italy; "The Development of Summer Lighting," by Mr. E. A. Leslie, Brooklyn, N. Y.; "Notes on Commercial Features of European Lighting Practice," by Mr. Arthur Williams, New York, N. Y.

Mr. Louis A. Ferguson, of Chicago, is president, and Mr. Wilson S. Howell, of New York, secretary.

The New Denver Telephone Exchange of the Colorado Telephone Company.

BY C. W. WHITNEY.

FIG. 1.—DOORWAY, DENVER TELEPHONE EXCHANGE.

THE Colorado Telephone Company has recently completed and is now occupying a handsome new four-story building at 1421 Champa Street, Denver. The company had entirely outgrown its former building on Lawrence Street, which itself was a comparatively modern building. In the new building are located the company's main exchange and the local and general business offices for the management of the entire telephone system of the State. Practically everything in the building, except some of the office furnishings, is new and of the most modern construction, this being especially true of the electrical equipment.

The structure, which is known as the Telephone Building, is a four-story and basement building and has ground dimensions of 75 x 125 ft., is entirely fire-proof throughout, having a steel frame consisting of 24-in. main girders and 12-in. laterals, with cast-steel columns. The floors are formed of tile laid in flat-arch construction, with the hardwood floor laid on lag strips. Omaha cream pressed brick and pressed terra-cotta tiling are used for the front, with stiff

FIG. 2.—NEW TELEPHONE BUILDING, COLORADO TELEPHONE COMPANY, DENVER.

mud brick for the side and rear walls. All partition walls are of tiles, while the ventilating flues in the side walls are built of square sewer tile. The building is designed for six stories, and the fifth floor is already laid, being now used as the attic floor. The hall floors are laid with marble tiling and in the operating rooms a marble lithic tile floor is used. Portland cement is used for the basement floor. A very handsome design has been used for the

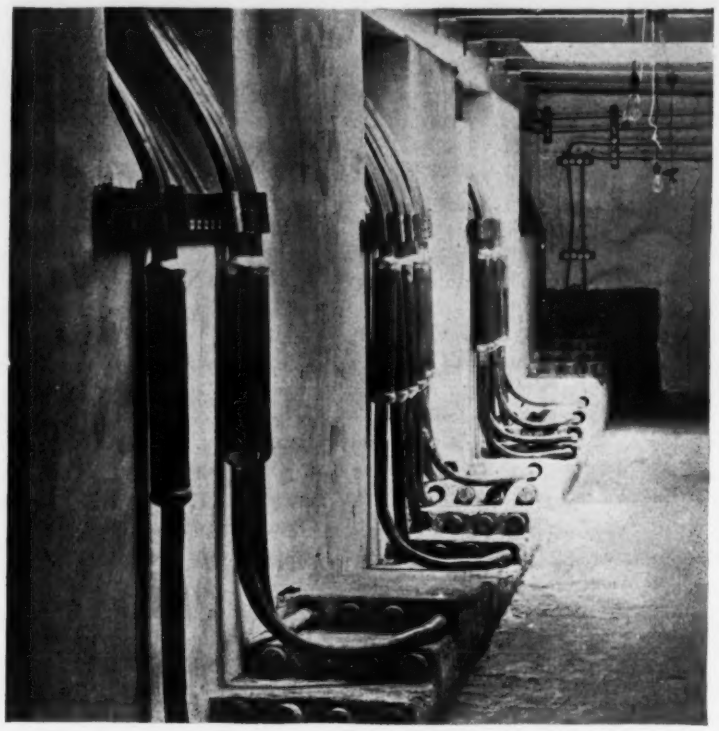


FIG. 3.—UNDERGROUND CABLES ENTERING BASEMENT AND CARRIED TO CABLE SLOTS.

entrance of the building, the emblematic bell being the chief feature of the terra-cotta repousse work and also of the stained-glass window over the doors. The architect for the building was the F. E. Edbrooke Architect Company, of Denver.

CABLE RUN.

The 400-pair underground cables connecting with the underground distribution of the city enter the basement of the building from the alley. A new method of taking the cables out of the ducts is used, as may be seen in the accompanying cut, Fig. 3. The ends of the ducts are inclined and arranged in horizontal rows of four, with four rows in a set. There are four of these sets and each is directly under a vertical cable slot, through which the cables are carried to the cable terminal and distributing room on the third floor. Provision is thus made for the entrance of 64 400-pair cables. At present there are 17 400-pair No. 22 paper-insulated lead-covered cables and one 50-pair cables entering this cable room. The 400-pair cables divide into two branches, each consisting of a 200-pair wood and lead-covered cable, for the distribution to the main cable racks above.

The cable slots are 5 in. wide and 4 ft. 6 in. long, and are constructed of tile in a special wall supported on steel columns, which are entirely independent of the columns supporting the building proper. The slots are plastered smooth on the inside with Colorado portland cement. At each floor there are openings in the slots and clamping stations for supporting the cables. Each cable is clamped by means of a galvanized clamp bolted to an iron strip, which hooks over a steel I-beam embedded in the masonry. Each cable is easily accessible and can be taken out or repaired without interfering with the others.

CABLE DISTRIBUTION.

The 200-pair cables enter the west side of the distributing room and are carried under Linden steel-plate flooring to the vertical racks of the main distributing frame. Each vertical is designed to carry 250 pairs of lines, but at present is equipped with only 200 protectors. Of the 58 verticals on the frame, 35 are now equipped. When the capacity of the exchange will require the additional 50 protectors on top of each rack, a 200-pair cable will be split in four 50-pair cables, one going to the top of each vertical.

From the verticals the circuits are carried to the 10-rack horizontal side of the frame and there combined into 20-pair flat cables, in which form they are carried to the intermediate distributing frame. From this frame the three-wire circuits are carried in 20-circuit

cables to the subscribers' multiple and trunking boards on the floor above. Back of the intermediate frame are the relay racks, while in the southwest corner of the room are coil racks and the fuse board. All of the telephone apparatus is built in conformity with the latest and most approved practice of the Western Electric Company, of Chicago. All cabling throughout the exchange is run in 10, 20 or 50-pair flat cable, which makes a very compact construction.

The fuseboard is about 10 ft. high and is formed of two black slate panels. There is a fuse on this board for each pair of operators' cords on the subscribers' board. There being 17 cords to each position, the fuses are arranged in sets of 17. There are also on this board for each operator's position three fuses for line signal lamps, two for supervisory lamps and one for the operator's transmitter battery circuit. Each subscriber's circuit is thus protected when making a call through the operator's cord, while additional protection is given by three supervisory-lamp fuses installed on the board for each position and by fuses for each set of three operator's cords. The fuses on the fuseboard are arranged so that when one blows a spring makes contact with a third bus-bar, thus completing a new circuit, lighting a signal lamp on the end of the row and ringing a bell to call the attention of the trouble man, Fig. 4.

POWER EQUIPMENT.

The power installation consists of a three-panel switchboard, two duplicate motor-generator charging sets, a 11-cell storage battery and ringing and testing machines, Fig. 8. Each charging set consists of a 20-hp, 500-volt, direct-current motor driving through a mechanical connection a 30-volt, 400-amp. generator. Power is regularly obtained from the 440-volt lighting circuit of the Denver Gas & Electric Company, but a reserve connection is provided with the 500-volt railway circuit of the Denver City Tramway Company.

The switchboard is built of black slate and is equipped with flush instruments. On the first or motor panel is a 500-amp., double-reading ammeter, rheostats, single-pole field switches and 500-amp., double-pole, single-throw, quick-break switches for the motors. At the bottom of the panel is a double-pole, double-throw main switch for throwing the system on the 440-volt lighting circuit or on the reserve 500-volt railway circuit. When the 500-volt current is used field resistance of the motors is cut out so as to keep the speed of the generators uniform.

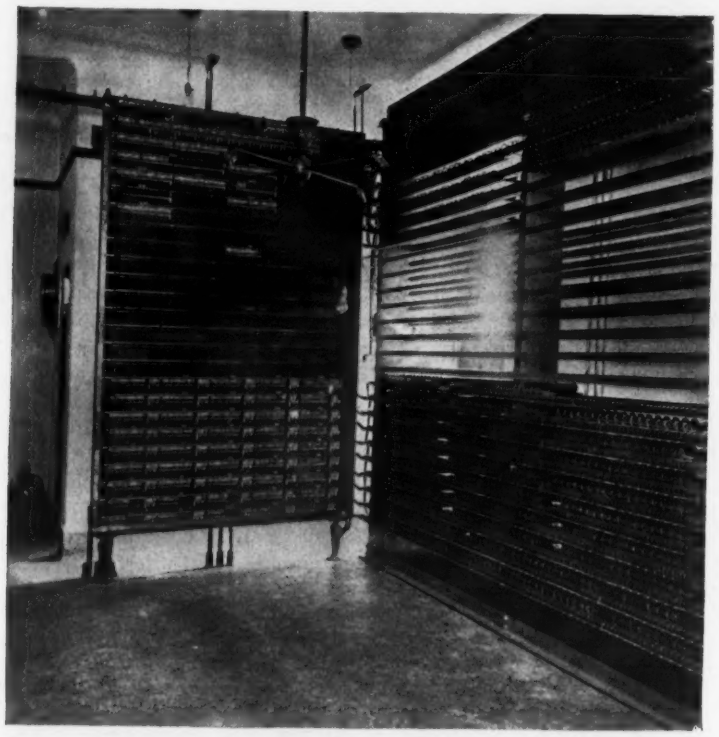


FIG. 4.—FUSE BOARD AND COIL RACK.

The second panel has a Weston 500-amp. ammeter, with switch for the 11 cells of battery and for two counter e.m.f cells. This panel also has the switches for the ringing and testing machines. The storage battery is controlled from the third panel, which is equipped with a 40 or 4-volt voltmeter and a commutator switch for reading the voltage of the individual cells. Two double-pole, single-throw switches control the generator circuits. The circuit-breakers are provided with reverse-current coils for throwing the breakers in case a generator should be cut in to charge the battery with a voltage lower than the battery voltage.

The storage battery is located in a small room adjoining the distributing and power room. It consists of 11 chloride lead cells

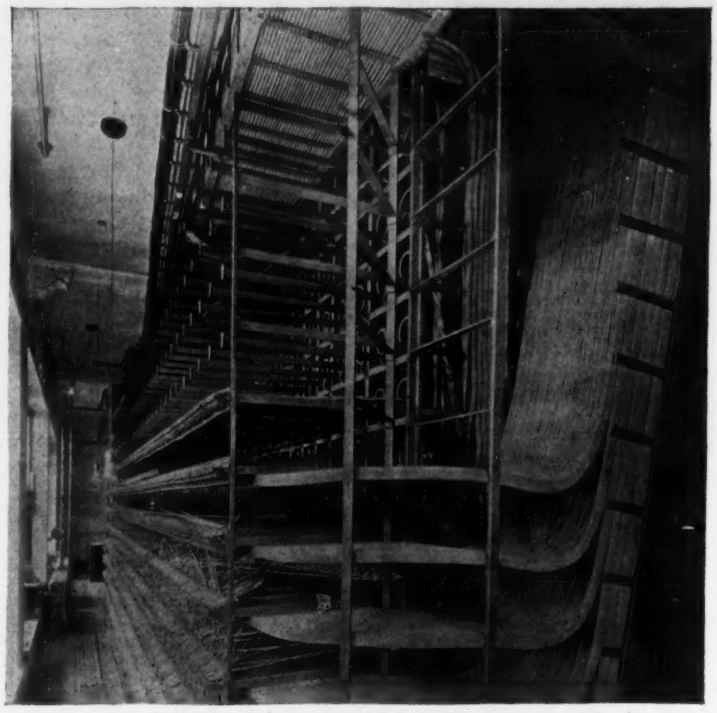


FIG. 5.—END OF INTERMEDIATE DISTRIBUTING FRAME, SHOWING 20-DUCT TRIPLE-LINE CABLES LEADING TO MULTIPLE BOARD.

made by the Electric Storage Battery Company, equipped with 21 plates, but with space for 10 additional plates. The normal rate of charge of the battery is 200 amp. The cells are set up on wooden boxes, which, when drawn out, allow the cells to be dropped away from the plates and removed. For supporting the plates a pipe is hung from the ceiling on which a block and tackle can be easily arranged. A Bristol recording amperemeter for the battery is mounted near the battery room door. Two counter e.m.f. cells are provided for holding down the voltage to 20 volts for the ringing machines, while the battery is being charged.

The rest of the power equipment includes two combination ringing machines, a 440-volt primary motor-generator set, with 200-volt, 2-amp. secondary for supplying current for the telegraph circuits, a Crocker-Wheeler ¼-hp motor-generator for giving 500 to 700-volt current for use in making semi-annual cable tests, and a ringing machine for use on the toll lines during the day time.

OPERATING ROOM.

The main operating room of the exchange is 120 ft. long and 34 ft. wide for most of the length. At the south end the room widens out 10 ft. more to make space for the stairway to the operators' quarters on the floor below. The main subscribers' or A switchboard is located in straight sections on the west side of the room. It is 90 ft. 8 in. long and is 4 ft. 3¾ in. wide, and forms one of the longest straight stretches of switchboard in the country. It is a standard local relay, multiple, central-energy, lamp-signal board and consists of 16 eight-panel, three-position sections. The ultimate equipment of the board will have a total capacity of 9,600 lines, divided into 26 sections. Space is provided for adding two new sections to the present board, making the total length of the straight 18-section board 102 ft. The other eight sections will be placed on the opposite side of the room towards the south end. (See Figs. 5, 6, 7, 9, 10, 11, 12 and 13.)

The board is equipped with Montauk fire cable and is further protected with extinguishers and sand and blankets. There are also asbestos fire panels between the cord shelf and multiple cables. Rolling curtains are provided for the back of the board instead of movable panels. All the operators' telephone apparatus is located on a special shelf and is covered with hinged tin covers. This shelf

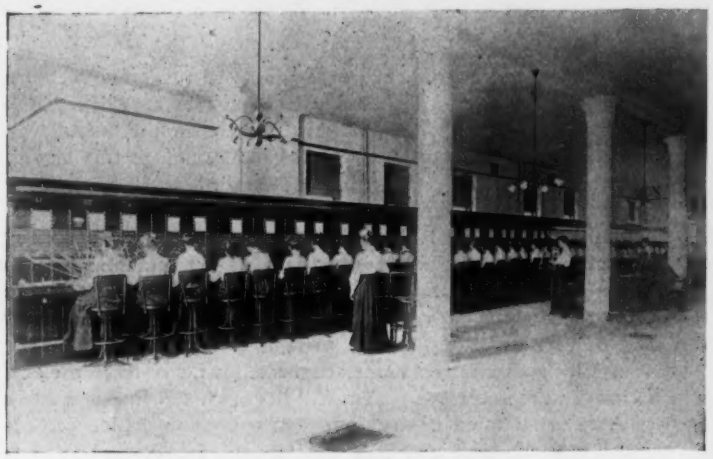


FIG. 6.—MAIN A SWITCHBOARD IN OPERATION.

FIG. 8.—FOUR-POSITION WIRE CHIEF'S DESK, POWER PLANT, END OF RELAY RACK AND INTERMEDIATE DISTRIBUTING FRAME.

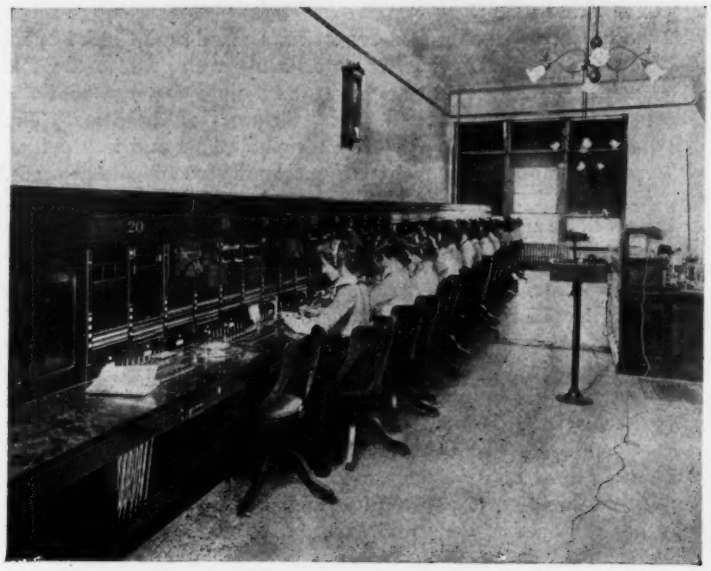


FIG. 7.—TOLL BOARD, SHOWING LINE OPERATORS' SECTIONS AND CHIEF OPERATOR'S DESK.

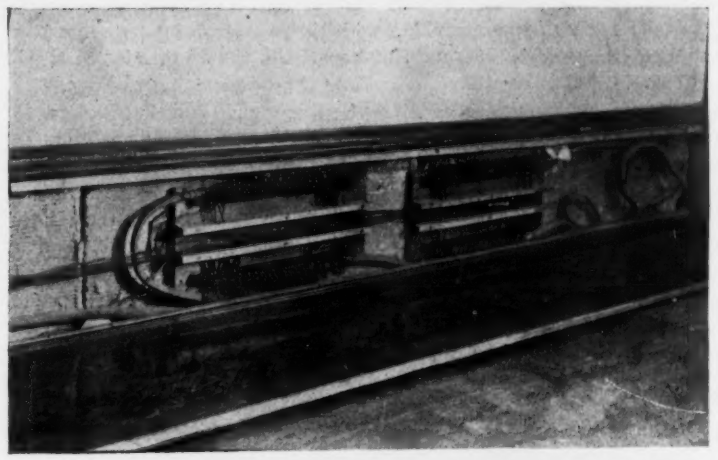


FIG. 9.—DETAIL OF REMOVABLE BASEBOARD, SHOWING WIRING TERMINALS FOR DESKS, ETC.

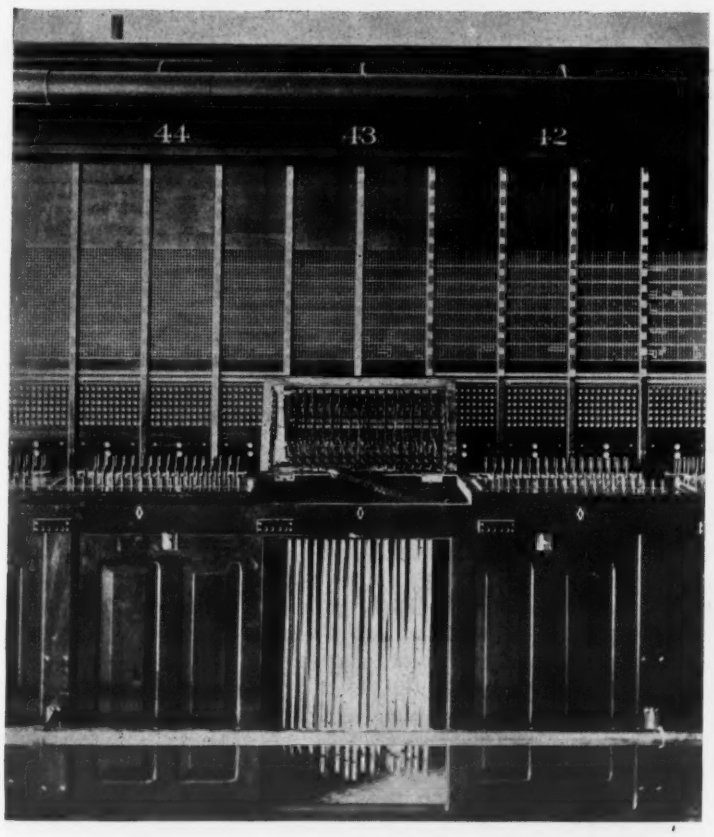


FIG. 10.—EIGHT-PANEL, THREE-POSITION SECTION OF MAIN A BOARD, WITH ONE OPERATOR'S CIRCUIT EXPOSED.

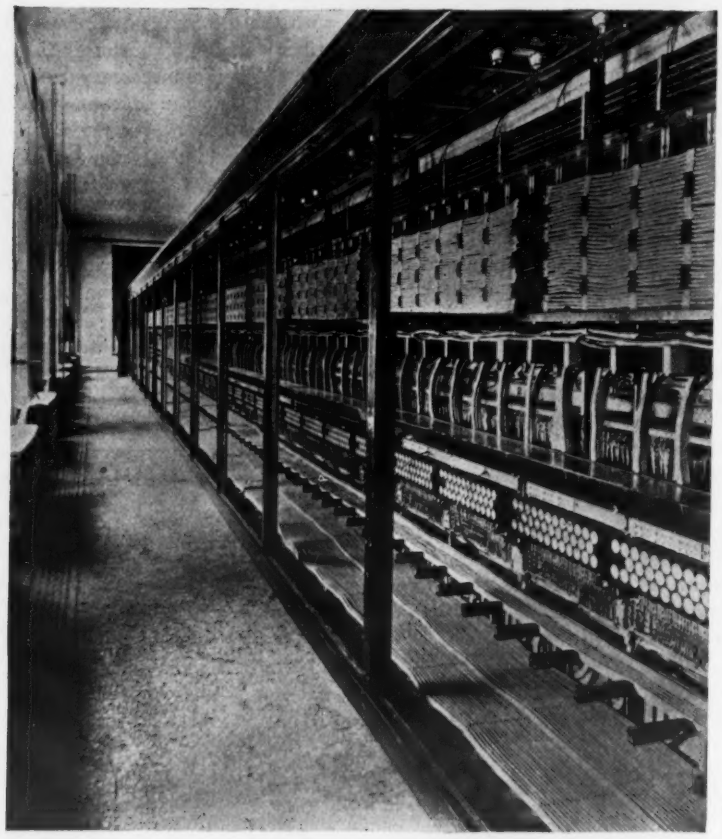


FIG. 11.—REAR OF MAIN A SWITCHBOARD FROM SOUTH END.

VIEWS OF THE DENVER EXCHANGE, COLORADO TELEPHONE COMPANY.

is just back of and below the cord shelf, instead of at the top of the frame as formerly.

The present capacity of the board is 5,600 lines and there are connected 4,027 multiple lines, carrying 6,815 stations, of which 5,090 are business stations and 1,725 residence stations. There are also 400 party line circuits on the board, but these are not on the multiples. The board has 47 operators' positions, panel No. 46 on the extreme left being equipped with voltmeter and other apparatus for testing. All preliminary testing is done by this operator, who reports to the operators at the four-position wire chief's desk in the distributing room on the floor below. This position will eventually be connected with the wire chiefs by pneumatic tube service for sending reports of trouble.

Next to this testing position is one provided with 160 jacks for the company's private branch exchange.

The service distribution on the board is made up as follows: 1,258 flat-rate lines carrying 2,040 stations, 1,781 message rate tally lines supplying 2,262 stations; 503 prepayment nickel lines carrying 1,985 stations, and 485 automatic pay station lines, carrying 527 stations. The 503 prepayment nickel lines are divided into 361 10-party lines and 142 two-party lines. As a rule not more than six stations are put on a 10-party circuit, and the designation strips are marked for the stations actually in service on the different lines. The operator's shelf is provided with throw-over levers, so that the calling party may be cut out and kept from the connection desired until the nickel is registered.

Different markings are used on the line signal lamps to designate the various classes of service and for some of the lines cut glass is used over the lamps. On the automatic pay station lines, which supply drug stores, restaurants, hotels and saloons, a separate color is used to distinguish the drug store stations from the others. In accordance with the city charter, the company is required to give free physician calls from drug stores, and the different colored lamps are used so that no physician may be called from a hotel, restaurant or saloon without the paying of the regular charge. On the multiple section of the board the different jacks belonging to the trunk lines of a firm having a private branch exchange are enclosed by white lines, so as to aid the operator in getting connection with that firm's private operator.

There are five supervisors for the subscribers' board and they are provided with stands in accordance with the latest practice of the Bell Company. There is also a manager's desk and at the north end of the room is installed a four-position information desk. The operators at this board are connected with the different positions on the A board and are, from the subscriber's standpoint, the "chief operators" of the exchange. So many trivial and unnecessary calls are made for the "chief operator" that the subscriber is connected with one of the information clerks, who invariably can give the same satisfaction to the complaining subscriber as could the manager of the operating room, who is thus relieved of a vast amount of trouble. The information clerks also are called upon to answer a vast number of questions as to the time of day, the baseball score, the time of trains, train reports, location of fires and anything else of interest. Their principal work, however, is supplying information concerning numbers of new subscribers and addresses of subscribers.

Back of the board is a clerk with two complete card indices. One index contains the names and addresses of subscribers, arranged numerically according to their telephone numbers. The other index is one not usually found in large telephone exchanges. It is indexed alphabetically by streets and numerically by street numbers under the different subscribers' stations. This index is used to supply information as to the name or telephone number of a party living at a certain address. The company has as many as 100 calls a day from people who have remembered the addresses of subscribers, but have not in mind the person's name or his telephone number. The company's ability to supply this information has been a great convenience to the subscribers.

Across from the subscribers' board at the north end of the room is the trunking or B board. This board now has five two-position sections and when completed will have three additional sections.

TOLL BOARD.

In a room 20 ft. long and 18 ft. wide, next to the local operating room, is the toll board. This board is divided into 10 two-position line operators' sections on the north side and three two-position recording operators' sections on the south side. Next to the recording sections is the toll-receiving and distributing clerk. The ultimate equipment of the toll board will consist of 24 two-position sections.

The toll board is provided with a pneumatic tube system for distributing the toll orders, similar to that in use in the New York and Philadelphia Bell exchanges. In the old exchange this service was performed by young girls. The recording operators receive the requests for toll connections from the subscribers through the local switchboard. They record the information concerning the desired toll connection on a slip, which is carried by a pneumatic tube to the receiving and distributing clerk. This clerk sends the order to the proper toll-line operator, who makes the desired connection. On the shelf of each recording section there is installed a dater of the American Clock Company's make, connected with a master clock, which changes the dates every minute. For each toll-line operator's section there is mounted in the shelf a calculagraph, which records on the toll slip the time and date and the elapsed time of the toll connection.

The blower for the pneumatic service is a No. 2 Green rotary blower and is installed in the attic. It is driven by a 2¾-hp, 500-volt, direct-connected motor.

In the toll board room are a supervisor's stand and a chief operator's desk, the title of chief operator being restricted to the toll department. There are at present 41 total lines leaving from the Denver exchange and connecting with all parts of the State. The toll wire chief's desk is in the cable terminal room and is provided with resistance and galvanometer for testing for trouble and grounds, the Varley test being used. Further mention of the company's toll business will be made later.

NEW BOARD CUT OVER IN THREE MINUTES.

The new switchboards were cut into service on July 12, the cut over from the old exchange occupying but three minutes. At the old cable room strings had been attached to the protectors on the verticals of the main distributing frame and at a given signal they were all pulled out, thus cutting off the old exchange. At the same time each of the operators on the new board plugged into the answering jacks, which operation opened the relay coils and let fall small mica or celluloid discs that had been placed in the coils to insulate them. Men in the cable room assisted in removing any discs that did not fall when the operators plugged in.

The company in the main exchange is handling about 50,000 line calls a day, about 15,000 incoming trunk calls and 8,000 outgoing trunk calls.

OPERATORS' QUARTERS AND OFFICES.

On the third floor, besides the cable terminal and power room already described, there are a locker room with expanded metal lockers, a well-appointed toilet room, a retiring or rest room, a lunch room and kitchen and an invalids' room for the operators. The offices of the traffic manager are also on this floor.

The second floor contains the handsome quarters of the president and general manager, E. B. Field, which are finished in Flemish oak. Other offices on this floor include those of the accounting and the engineering departments and the general superintendent. On the first floor are a well-arranged public office, with six long-distance telephone booths, the treasurer's department, collector's room, contract department, recording and filing clerk and stationery and store room. The basement contains the maintenance department, the equipment work room and the A. D. T. department. In the northwest corner of the basement are installed two 80-hp tubular boilers. These boilers are used for heating the building, but are built for power purposes so that if necessary a power plant may be installed.

LIGHTING AND WIRING FEATURES.

The building is very well lighted by windows and skylights and excellent artificial lighting is supplied by incandescent lamps. All wiring is run in steel bricated conduit and floor outlets are provided at various points in the different rooms for desk lights. The telephone switchboards are lighted by the trough system. In the center of the building is a wire and pipe shaft through which the steam and water pipes and light wires are carried to the different floors.

A very useful feature of the building is the system of baseboard wiring for the local telephone service. Starting from the company's private branch exchange position on the main board, trunk line cables are carried down the pipe shaft, connecting racks being placed at each floor. From these racks branch cables are carried to a central location in each department. These locations are generally behind the baseboard and from them cables are run to the different desks in the department. All the wooden baseboards in the building are removable and are lined with tile. One of these cable locations

is shown in the accompanying illustration. Under the floors connecting with numerous outlets for the desks are galvanized iron ducts covered with 3/16-in. Linden steel floor plates. These plates protect the cables from any nails that might be driven through the floor. The molding in many of the rooms is wired and cables may also be run from the intermediate frame through the tile ventilating flues with outlets through the registers. In this way telephone wires may be run to any point in the building and any desired connection

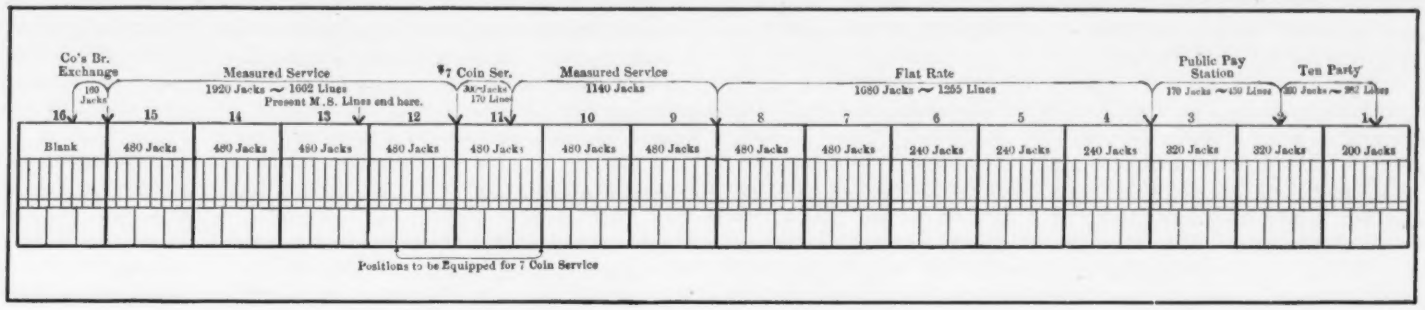


FIG. 12.—DIAGRAM OF SWITCHBOARD PLAN.

made without damaging the floor or walls. By cross-connecting the baseboard terminals circuits may be provided for bells, buzzers, private telephones, clock service, fire alarms or almost anything requiring electrical connections.

The engineering department plans to install an independent power switchboard for miscellaneous purposes, in a space back of the main power board in the terminal room. This board will be equipped with a variety of apparatus for testing purposes, private storage battery service, telegraph circuits, clock daters, A. D. T. power and anything else that is distinguished from the general power supply.

OTHER DENVER EXCHANGES AND LOCAL DISTRIBUTION.

The Colorado Telephone Company has two branch exchanges in Denver, the South and York exchanges, and these also are equipped with relay multiple central-energy boards, so that the entire city system is now using the latest and most modern apparatus. In all three exchanges there are 5,474 lines connected supplying 10,061 stations. The distribution of the different services for the three exchanges is as follows: 1,467 flat rate lines, carrying 2,292 stations; 202 message rate meter lines, carrying 260 stations; 2,336 message rate tally lines, carrying 3,083 stations; 905 prepayment nickel lines, carrying 3,813 stations; 564 automatic pay lines, carrying 613 stations.

The underground district of the city covers an area about three miles long by one-half mile wide and the district is being extended in the southern part of the city. There is a total length of conduit trench of 61,995 ft., this length being exclusive of the length of manholes, of which there are 230. The total capacity of the conduit in duct feet is 477,647 ft. About 22,000 ft. of bituminized fibre conduit, the American Conduit Company's make, has been laid during the last year, but most of the conduit is Camp vitrified clay, single duct.

Leaving the main exchange there are 17 400-pair lead-covered paper-insulated cables and one 50-pair lead cable. Multiple cables are used throughout in distributing. There is a total of 210,000 ft. of underground cable installed in the city, of which 6,200 ft. is 400-pair, 73,000 ft. 200-pair, 115,000 ft. 100-pair and 10,000 ft. 50-pair cable, the remainder being 70, 60, 55, 30, 25 and 20-pair cable.

The aerial distribution from all three exchanges comprise 430 miles of pole lines carrying 5,190 miles of wire, and includes 71,689 ft. of 100-pair cable, 184,035 ft. of 50-pair cable and 9,693 ft. of 25-pair cable.

The maintenance department of the telephone company is now busy taking out the old instrument magnets and installing the new common-battery telephones. About 150 changes are being made daily. In this department there are employed 120 men, including the wire chiefs, and their work embraces the maintenance of the entire State, as well as the local system. Upon cutting in the new telephone switchboard there were only 145 permanent signals of trouble on the board, while as many as 700 or 800 would not have been unusual. Twenty days after the new board was started there were only seven permanent trouble signals on the main exchange. This is also considered a remarkably low record, as on a board of this size from 75 to 80 permanent trouble signals might reasonably be expected.

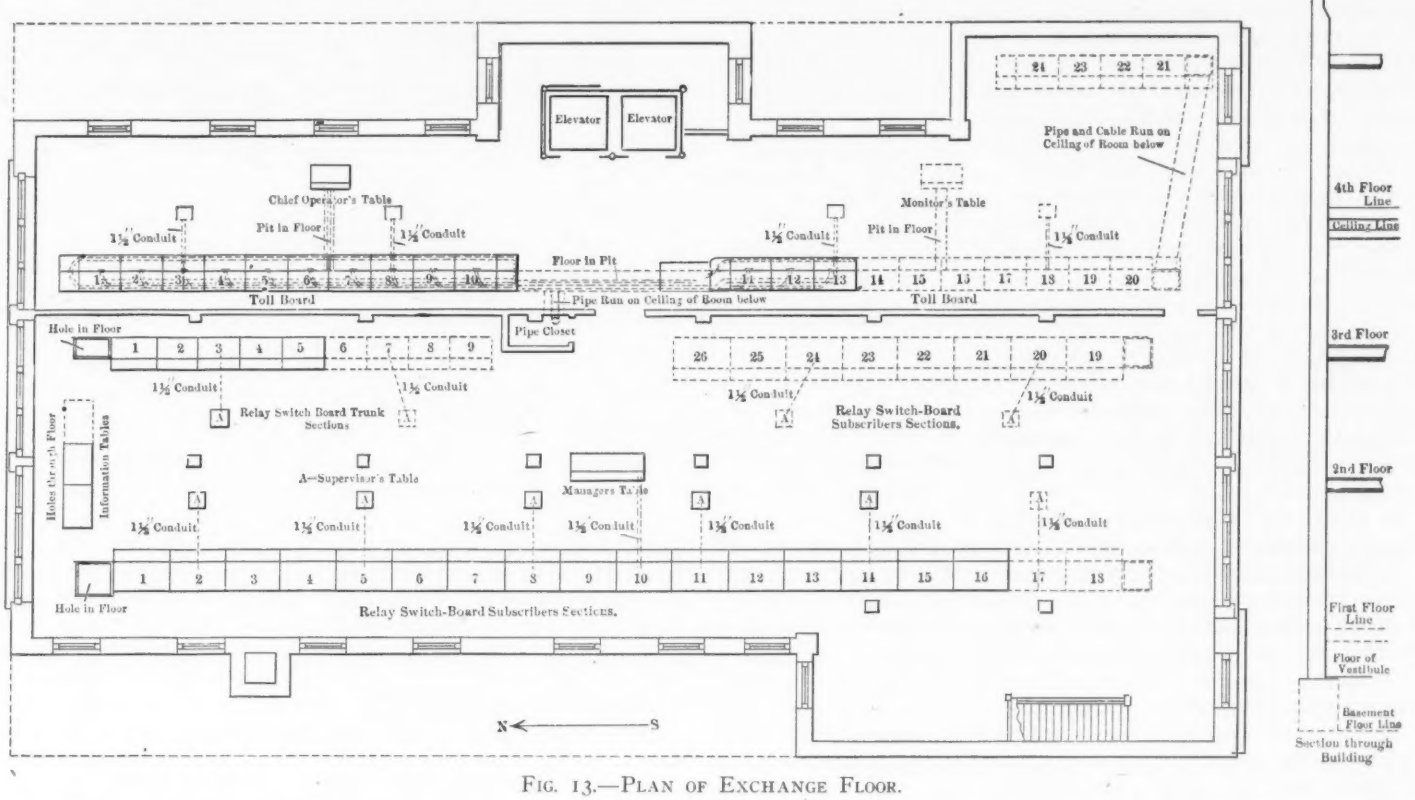


FIG. 13.—PLAN OF EXCHANGE FLOOR.

DENVER RATES.

The business and professional rates for telephone service in Denver are as follows: Unmeasured service, individual line, $120 a year; measured service, individual line, 400 calls, $50, with a sliding scale and four and three cents for excess calls; two-party line, 400 calls, $42 and up, with five and four cents for excess calls; 10-party nickel line, seven cents a day; public pay station line, $5 guarantee a month and conversations five cents each. Residence rates for unmeasured service are $90 for individual lines and $66 for two-party lines; measured service, individual line, is $42 for 400 calls and two-party line, $30 for 400 calls, both with sliding scales above 400 calls; two-party lines guarantee 10 cents a day and 10-party lines guarantee five cents a day; individual lines, with coin-receiving device, are $4 for 60 calls per month.

TOLL LINES AND STATE EXCHANGE.

Colorado is unique for a Western State, in that it has more toll lines per capita than any other State outside of New York. As shown on the map in Fig. 14, the toll lines of the company radiate from Denver, Colorado Springs and Pueblo and reach all the important cities and mining camps in the State, while connections with Wyoming, Montana and Utah are obtained through the Rocky Mountain Bell Telephone Company's system at Cheyenne, Wyoming. There are now in operation or ordered for immediate construction 2,300 miles of toll pole lines, carrying 12,000 miles of copper wire.

Of the 41 toll lines radiating from Denver, 15 circuits lead to Colorado Springs, 9 of them going on to Pueblo and southern points. From Colorado Springs to Cripple Creek there are 20 circuits, this forming the heaviest toll line in the State. This large number of circuits is occasioned by the large amount of mining business done in the Cripple Creek District. Many of the mine owners live in Colorado Springs and there are several private lines for their use.

Leading west from Denver to Central City there are nine circuits and three of these are continued west to the Leadville district and from there two lines are carried farther on to Glenwood Springs and Grand Junction in the western part of the State. Beyond Central City the lines cross the Continental Divide over Argentine Pass at an elevation of nearly 14,000 ft., the circuits being carried in three No. 9 and No. 12 two-pair submarine cables for a distance of 1½ miles. The circuits are carried over Mosquito Pass and Independence Pass in similar manner. The cables are buried a short distance in the ground so that they will not be damaged by snow or wind.

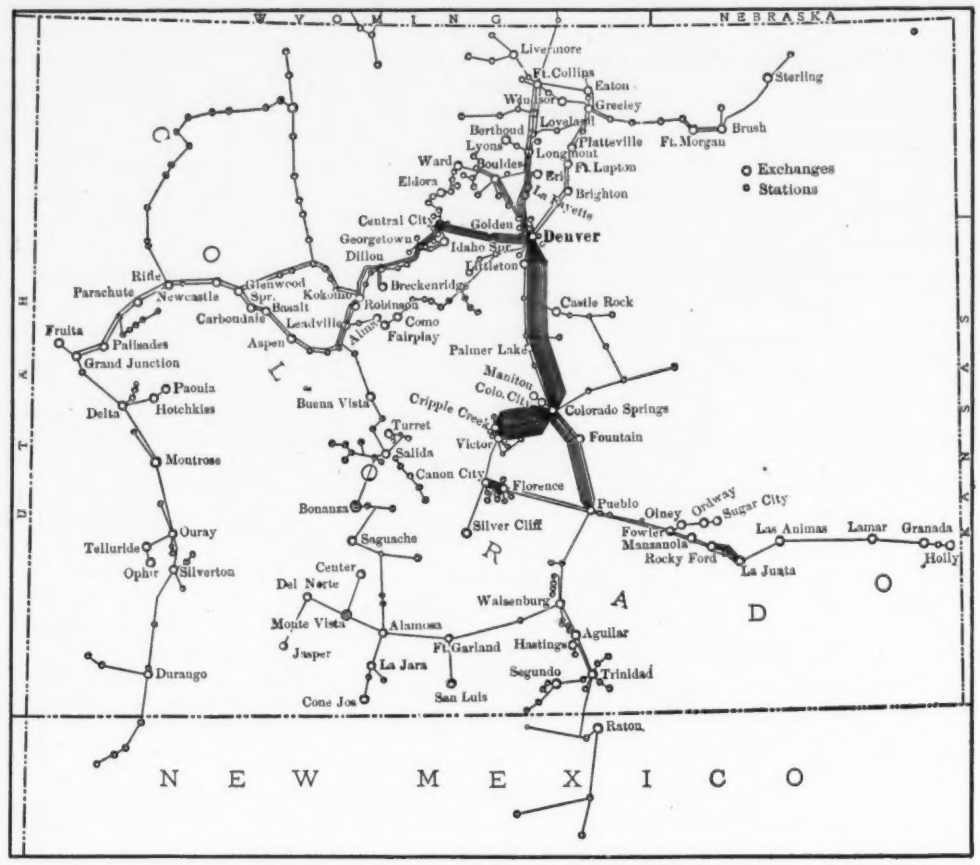


FIG. 14.—PRINCIPAL TOLL LINES AND CONNECTIONS, COLORADO TELEPHONE COMPANY.

In Pueblo the company has recently completed an additional story on its exchange building and has installed a new common-battery equipment with an ultimate capacity of 4,200 lines. The present equipment of the exchange is 1,600 lines carrying 2,500 subscribers. In most of the town wires have been placed underground, the Camp single-duct conduit being used.

At Salida a new building has just been completed and a common-battery equipment installed with an ultimate capacity of 1,000 lines, equipped for 400 lines. This new board takes the place of an exchange outfit that was installed about five years ago by the Salida Telephone Company, which has since sold out its business to the Colorado Telephone Company.

During the last few months the company has completed a new copper toll line from Delta to Paonia, a distance of 35 miles. Small exchanges are located at Paonia and Hotchkiss, these towns with Delta being located in the recently developed fruit section in the Western part of the State.

The company has at present under way the construction of a 30-mile line from Durango to Mancos, with an exchange at the latter point; a line from Buena Vista to Salida, 28 miles; one from Cripple Creek to Salida, 65 miles; one from Salida to Alamosa, 102 miles, and one from Alamosa, westerward to Del Norte, a distance of 30 miles.

Among the improvements planned for execution during the present year are a line from Georgetown to Hot Sulphur Springs, 50 miles, on the route of the new Moffat Short Line, and the stringing of additional circuits on the lines between Denver and Trinidad, Denver and Cheyenne and Grand Junction and Durango. The lines to Cheyenne will connect with those of the Rocky Mountain Bell Telephone Company, now being built from Cheyenne into Montana.

At Trinidad the Colorado company has purchased ground and is preparing plans for the erection of a new exchange building. A common-battery system will be installed and the wires will be placed underground in the business part of the city. Trinidad has a population of 7,000 people, and has 1,080 telephone subscribers, a very large proportion for a Bell operating company, and one that might be envied by many Eastern Bell exchanges.

At Boulder ground has been purchased and plans are being prepared for an exchange building that will have a common-battery system, with ultimate capacity of 1,600 lines, equipped with 600 lines for 800 subscribers. The wires in the business district will be put underground. At Farmington, New Mexico, a new exchange is to be opened with 125 subscribers, and a branch exchange at Aztec.

The Colorado company is also rebuilding its plants at Conejos, Del Norte, Monte Vista and Saguache. At Buena Vista the company has recently taken over the independent automatic system, remodeling the plant and installing its own apparatus.

The company is now extending its southern limit from Raton, New Mexico, to Las Vegas, 120 miles distant. On the east the system extends to Holly, Colo., six miles from the Kansas State boundary. The western limit is Grand Junction, while on the north the system ends at Cheyenne, Wyo. Although the Colorado system crosses the southern boundary of the State at two points and almost touches the eastern and western boundaries, it has only one connecting point with other systems, that being at Cheyenne, as already mentioned.

Throughout its whole toll system the company uses a high-grade construction, with Nos. 12, 9 and 8 all copper metallic circuits. There are a very few grounded lines in the State, but they are being weeded out as rapidly as possible. An interesting piece of toll line work is used in the San Juan country, where on account of the heavy snow slides, cables cannot be used. The construction consists of long spans from 1,000 to 1,400 ft. in length stretched from one rocky point to another, the highest grade ¼-in. steel strands being used. The maintenance of lines in that section is very expensive.

The rates for toll service run from 20 cents up, according to the distance, with lower rates for night service. All rates are based on the three-minute service system. As a rule, all orders for toll connections between exchanges are sent by telegraph over the company's own telephone wires. No commercial telegraph business is done.

The company has adopted the policy of collecting for a toll connection as soon as possible after it is made. The collecting is done twice a day, and it is very seldom that a bill is presented more than 24 hours after the service is given. In this way the subscriber can have no excuse to forget that he used the toll line, and the company has no bad accounts. This system seems to work with greater satisfaction in Denver than elsewhere, as in this city there are many transients, who would be gone before the monthly or quarterly collector could get around. The company gets out toll script in 5, 10 and 25-cent values, which is sold to the subscribers without discount. For large customers the company sells $600 worth of coupons for $480, the coupons being good for one year.

MANAGEMENT.

The inability of independent operating companies to obtain a footing in Colorado may be explained by the liberal and broad-minded policy adopted by E. B. Field, the president and general manager of the Colorado Telephone Company, in giving good service throughout the State and in endeavoring to meet the needs and demands of the public in every reasonable way. There is but little of that antagonistic feeling against the company that has prompted so many citizens in Western cities to interest themselves in companies to fight the Bell exchanges. There are but two or three independent exchanges in the State and none of them are said to be in an overprosperous condition. An ordinance for an independent franchise in Colorado Springs was recently defeated, and several members of the Denver Charter Convention have put themselves on record as opposed to a competing telephone company in that city.

The management of the Colorado company has always been an enterprising one, and many features that are now standard Bell practices were originated or early introduced in Denver. Mr. Field is ably seconded in his liberal policy by E. M. Burgess, general superintendent of the company, while other efficient officials are H. A. Rhodes, engineer; F. A. Cannon, superintendent of construction; C. L. Titus, superintendent of maintenance, and W. F. Brown, manager of the traffic and operating departments.

The Colorado Electric Light, Power and Railway Association.

As the result of a very enthusiastic meeting of electric lighting, power and street railway men in Denver, Colo., on August 12, the Colorado Electric Light, Power & Railway Association was organized. The meeting had been called by Mr. George B. Tripp, of Colorado Springs, and representatives were present from 19 companies operating in Denver, Colorado Springs, Pueblo, Greeley and other points in the State. Through the courtesy of Mr. Henry L. Doherty, the meeting was held in the rooms of the Denver Gas & Electric Company. J. F. Vail was made temporary chairman and a constitution and by-laws were adopted, subject to future correction. The following permanent officers were chosen to serve until the first annual meeting: President, J. F. Vail, general manager Pueblo & Suburban Traction & Lighting Company, Pueblo; vice-president, William Mayher, manager Greeley Power & Light Company, Greeley; secretary and treasurer, George B. Tripp, general manager Colorado Springs Electric Company, Colorado Springs. The headquarters of the association will be in Colorado Springs and annual meetings will be held on the last Wednesday in October. This will bring the next annual meeting on October 28 and it will be a two-days' session. The convention will be held in Denver, and papers on topics of interest to the members will be presented, while the social feature will not be neglected.

The association begins its existence with very promising prospects and the officers are confident that nearly all of the 55 companies in the State will become members. Dues will vary from $10 to $25 a year, according to the population of the city in which the company operates. The object of the association is "to foster and promote the common interests of its members and to advance scientific and practical knowledge in all matters relating to electric light, power and railway companies; also to establish cordial and beneficial relations with kindred associations and between the manufacturers of electrical machinery and appliances and the members."

To Whom do We Owe the Experiment of the Ball and Hemispherical Conductors, Showing That the Charge Resides on the Outer Surface of an Electrified Body?

BY BROTHER POTAMIAN, D. SC., LOND.,
PROFESSOR OF PHYSICS IN MANHATTAN COLLEGE, NEW YORK CITY.

PROFESSOR Silvanus P. Thompson, in his manual of electricity and magnetism, calls this ingenious method of demonstrating the fundamental principle of electrostatics, "Biot's experiment"; Everett enters no disclaimer in his translation of Deschanel's treatise, simply entitling it "the experiment of Biot"; Prof. Chrystal does the same in his article on electricity and magnetism in the last edition of the Encyclopædia Britannica, adding, however, in a foot note seven pages further on, that "the experiment was first made by Cavendish"; Prof. Reinold, in the 16th edition of Atkinson's "Ganot" goes a little further and divides the honor by saying that "the experiment was first made by Cavendish, but the apparatus is commonly

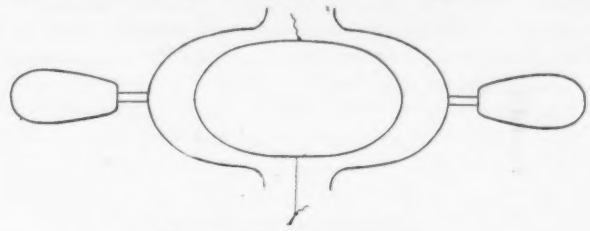


FIG. I.—BIOT'S EXPERIMENT.

known as Biot's"; lastly, French writers when they give the experiment a name, never fail to call it after the distinguished professor of the Collége de France. It was, therefore, with no inconsiderable surprise that I came across an exact description of this experimental demonstration in the electrical papers of Coulomb while reading them with a view to the bibliography of the Wheeler collection in the Library of the American Institute of Electrical Engineers, formerly the Latimer Clark Library at Westminster.

The passage occurs in the first volume of the *Collection de Mémoires relatifs à la Physique*, published in 1884 by the French Physical Society. It will be found on page 233, where it reads:

"Il faut se ressouvenir dans tous les articles de ce mémoire relatifs à la théorie:

1° Que le fluide électrique agit en raison inverse du carré des distances de ses parties;

2°Qu'il se distribue sur la surface des corps, mais qu'il ne pénètre pas au moins d'une manière sensible dans l'intérieur des corps. Nous avons prouvé la première proposition dans notre premier mémoire, volume de 1785; la deuxiéme, dans le quatrieme mémoire, imprimé en 1786. On peut la confirmer par une nouvelle expérience qui paraît decisive; voici en quoi elle consiste. On isole un corps conducteur que l'on électrise; on lui forme ensuite une enveloppe coupée en deux parties, qui laisse en se reunissant, un peu de jeu entre elle et le corps. Que cette enveloppe ait ou non la même figure que le corps, peu importe au succes de l'expérience. Si l'on électrise le corps placé sur un isoloir et qu'on le renferme entre ces deux parties de l'enveloppe, soutenues par deux bâtons idio-électriques, en retirant les deux enveloppes, on trouvera au moyen de nos petits électromètres à suspension de soie, que toute l'électricité du corps a passé aux enveloppes et que le corps, ou n'en conserve point, ou n'en conserve qu'une partie insensible."

The passage may be rendered as follows:

"One must keep in mind while reading the articles of this paper that have any bearing on electrical theory (1) that the electric fluid acts according to the law of the inverse square of the distance of its parts, and (2) that the electric charge resides on the surface of conductors penetrating them to no appreciable depth. The first proposition was proved in a paper of ours which the Académie inserted in its *Transactions* for 1785, and the second in the volume for 1786. The latter proposition may be confirmed by a new experiment which appears to be decisive. An insulated body is electrified and then surrounded by a conductor cut in two so that when the parts are brought together but little space is left between them and the enclosed body. It matters not to the success of the experiment whether the enveloping shell has or has not the same form as the body itself. The latter, after being electrified, is clasped by the divided shell, held by insulating handles; then, when the shell is removed, it will be found on testing with one of our little electrometers[1] that the charge has passed from the inner body out to the surrounding shell, leaving the body itself either neutral or with a charge so feeble that it cannot be detected."

[1] Described on page 178 of the memoir.

This clear description of an experiment which the author calls "new" and "decisive," and which has since become classical, was published in the proceedings of the *Académie des Sciences* for 1788, when Coulomb[2] was fifty-two years of age, and Biot[3] only fourteen. It is, therefore, plain that if we are to ascribe the experiment to a French physicist at all, it must go to Coulomb and not to Biot. No doubt, the latter did much by his books and especially his brilliant lectures to make the experiment widely known, and to popularize it; and, as he nowhere attributes it to himself, we are forced to conclude that some of his admiring pupils, perchance some maker of physical apparatus, took the liberty of affixing his name to it. Be this as it may, it was as thus christened that the experiment became familiarly known in the lecture room.

The apparatus used by Biot is outlined in his *Traité de Physique expérimentale et Mathématique* (Paris, 1816), where it appears as an ellipsoid suspended by a silk thread and surrounded by a pair of closely-fitting conductors of the same form, provided with insulating handles, Fig. 1. No name is associated with it in the text; a fact that is rather surprising when we remember that Biot was thoroughly conversant not only with all the published papers of Coulomb from which he gives copious extracts, but even with his manuscripts to which he occasionally refers. Moreover, as Biot was an unstinted admirer of the great engineer and electrician, it is not easy to account for this omission of Coulomb's name in connection with an experiment which was then, as well as now, considered to be one of primary importance.

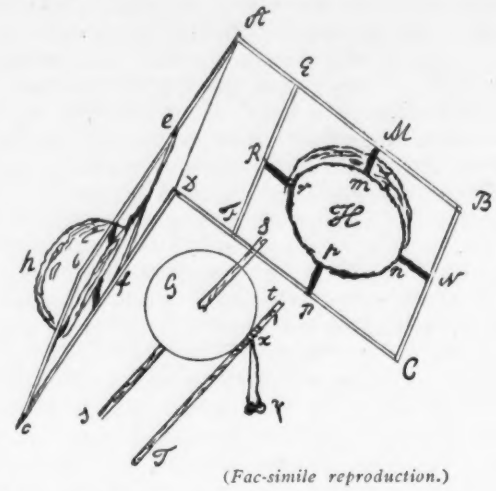
In taking leave of the *Mémoires* of Coulomb, I cannot but recall the words of Prof. Chrystal in his admirable article of one hundred papers on "Electricity and Magnetism," already referred to. On page 21 he writes: "Nothing is better calculated to rouse the failing enthusiasm of the tyro in experimental electricity than a perusal of the works of Coulomb, unless it be to read the *Experimental Researches* of Faraday."

We shall now consider the claims of that quiet, methodical and persistent delver into the secrets of nature, the Honorable Henry Cavendish.[4]

Clerk Maxwell describes the experiment of the ball and hemispheres on page 81 of the first volume of his *Treatise on Electricity and Magnetism*, and speaks of it as belonging to Cavendish. Prof. J. J. Thomson does the same on page 33 of his *Elements of Electricity and Magnetism*, while Principal Lodge, in his *Modern Views of Electricity*, page 11, writes of it as "the famous Cavendish experiment, sometimes referred to in French books by the name of Biot."

Let us see what Cavendish undertook and what he really did. Turning to Art. 218, page 105, of his *Electrical Researches*, as edited by Clerk Maxwell, and published in 1879, we read: "The intention of the following experiment was to find out whether when a hollow globe is electrified, a smaller globe enclosed within it and communicating with the outer one by some conducting substance is rendered at all over or undercharged, and thereby to discover the law of electric attraction and repulsion."

The apparatus which he devised and which is illustrated in the text, consisted of a fixed globe on an insulating support and a pair of hinged wooden frames with two pasteboard hemispheres attached to them by means of glass rods, Fig. 2. When the hemispheres were



(*Fac-simile reproduction.*)

FIG. 2.—BALL AND HEMISPHERES OF CAVENDISH.

brought together, they formed an insulated spherical shell concentric with the globe. A wire held by a silk thread and easily removable served to establish communication between the two systems formed by the globe and surrounding shell. The method of operating is given in the paper as well as the results obtained, after which Cavendish states his general conclusion, on page 110, in the following words: "It thus appears that if a globe 12.1 in. in diameter is enclosed within a hollow globe 13.3 in. in diameter, communicating with it by some conducting substance and the whole is positively electrified, there is no reason to think from any circumstances of the experiment that the inner globe is at all overcharged. Hence, it follows that the electric attraction and repulsion must be inversely as the square of the distance."

Maxwell concludes his remarks on this experimental illustration of a great physical law by saying that the account of it given by Cavendish is "one of the most perfect examples of scientific exposition."

A difference in the manner of operating must be here noticed. Cavendish electrifies the hemispheres and then connects them to the inner globe. Severing this communication, he withdraws the hemispheres and tests the globe, which he finds to be neutral. Coulomb, on the other hand, communicates the charge directly to the insulated body, after which he applies the conductors, and shows that they carry off all the electricity. The difference of procedure, however, is one of detail; it involves no principle whatever.

Fig. 3 shows the apparatus as usually constructed for lecture-room purposes.

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[2] Coulomb, Charles Augustin de, born in Paris, 1736, where he died in 1806. In early youth he showed a great aptitude for mathematical studies. After entering the corps of military engineers, he was sent to the island of Martinique where he remained nine years. On his return to France, he shared with Van Swinden the prize offered by the *Académie des Sciences* in 1779 for the best method of constructing ship's compasses, and two years later won the prize offered by the same body for the theory of simple machines. It was in this paper that he described his celebrated experiments on friction. From 1784 to 1789, he was mainly occupied with his electric and magnetic work, presenting during that period seven lengthy papers to the Académie. Coulomb devised his torsion balance of which he made extensive use after satisfying himself that the angle of torsion is accurately proportional to the moment of the twisting couple. The reader will not fail to recall the $4\pi\rho$ proposition, now known as *Coulomb's Theorem* which states that the force just outside an electrified conductor is 4π times the density. It was indeed meet that the electrical unit of quantity should be named after him.

[3] Biot Jean Baptiste, 1774-1862. After a brilliant career at the lycée Louis le Grand and the Ecole Polytechnique, Biot was appointed in 1800 to the chair of physics in the Collége de France. Honors soon came to the young savant, being admitted in 1803 to the *Académie des Sciences* and appointed member of the *Bureau des longitudes* in 1804. He worked for some time in conjunction with Arago on the triangulation for the measurement of an arc of the meridian, begun in Spain by Méchain. The literary character of many of Biot's works, notably his "Researches on Ancient Astronomy," opened to him the door of the *Académie Francaise* in 1856. He was elected Fellow of the Royal Society (London) in 1815 and was awarded the Rumford medal in 1840 for his remarkable researches on the circular polarization of light.

[4] Cavendish, Henry, 1731-1810. Mathematician, chemist, physicist. His life was one of seclusion wholly devoted to the pursuit of science, a "set of stables" attached to his father's house being transformed into a laboratory for the purpose. With a torsion balance, originally suggested by Rev. John Michell, he determined the mean density of the earth, the average value of 29 measurements being 5.448. Professor Vernon Boys, working in 1895, obtained 5.527. Cavendish was elected to the Royal Society in 1760 and in 1772 we find him associated with Benjamin Franklin on a committee to consider the best means for protecting the powder magazine at Purfleet against lightning. One member, a certain Mr. Wilson, insisted on blunt lightning-rods, but the other four recommended pointed conductors. In his paper on the torpedo, Cavendish maintained that the shock was a real electrical phenomenon, constructing a wooden model by way of illustration with which he imitated in water the discharges of this singular electrical fish. He distinguished between quantity and degree of electrification just as we do between charge and potential. Accuracy was everything with him, appearance nothing. Some of his results are but little short of marvelous; thus he found the capacity of a circular disc to be 1/1.57 that of a sphere of equal radius; our formula is $C = \frac{2r}{\pi} = \frac{r}{1.5708}$! Cavendish may justly be considered as the co-founder with Coulomb of quantitative electricity. Dr. Wilson, his biographer, wrote: "His theory of the universe seems to have been that it consisted solely of a multitude of objects that could be weighed, numbered and measured; and the vocation to which he considered himself called, was to weigh, number and measure as many of these objects as his allotted three score years and ten would permit."

The question of priority yet remains. As we have seen, Coulomb's paper was published in 1788; the manuscript of Cavendish shows that the experiment was made by him on December 19, 1773[5]; that is fifteen years earlier. This chronological fact does not, however, detract one tittle from the merit of Coulomb, for the simple reason that Cavendish did not communicate his results to the scientific world, preferring to keep them by him in manuscript. Only two of his papers were printed during his lifetime, both in the *Phil. Trans.*, the first in 1771, entitled "An attempt to explain some of the principal phenomena of electricity by means of an elastic fluid," and the second in 1776—a very remarkable paper—on the torpedo. It is, therefore, highly probable that Coulomb was not acquainted, even by hearsay, with the electrical achievements of his illustrious but singularly reticent contemporary. Both studied experimentally the law of variation of electric force, both devised the same simple and ingenious experiment to determine it, and both concluded from their observations that no law but that of the inverse square of the distance would adequately account for the unelectrified condition of the inner globe. Science affords numerous instances of similar independent researches and discoveries: witness that of the calculus by Newton and Leibnitz, the Leyden jar by Von Kleist and Cunæus,

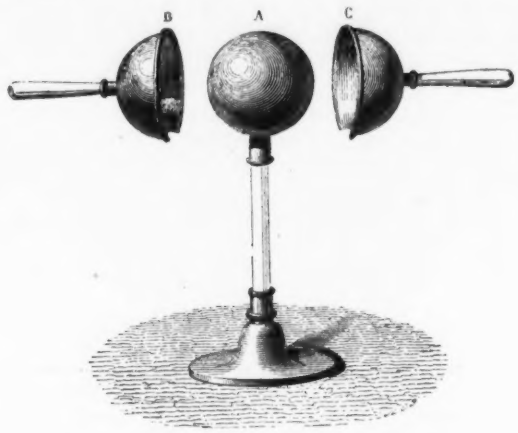


FIG. 3.—LECTURE ROOM APPARATUS.

and the mathematical discovery of the planet Neptune by Adams and Leverrier.

From the above brief exposition it will be seen (*a*) that Cavendish was the first to make the famous experiment suggesting the law of the inverse square, and (*b*) that Coulomb was the first by ninety years to publish it. If the present usage of deciding questions of priority by date of publication be held to apply to the experiment under consideration, then it must henceforth be credited to Coulomb. In any case, the name of Biot must be dropped.

Starting Induction Motors.

The well-known standard method of starting induction motors consists in inserting non-inductive resistance in the secondary of the motor, this resistance being gradually cut out as the motor runs up to full speed. If a rheostat with sliding contacts is used, there may be sparks, and such sparks are absolutely prohibitive if the motors are used for certain special purposes, for instance in flouring milles, oil refineries, etc. For such purposes a different method of starting has been devised by Mr. A. P. Zani, of Berlin, Germany, for which two patents were granted him on August 4. While this method is in principle the same as the method mentioned above, it is of an automatic nature, no rheostat being employed. The currents in the secondary are caused to flow through a circuit provided with alternative paths, one of high ohmic resistance and little if any self-induction, the other of low resistance, but of comparatively high self-induction. At starting when the slip is large and the frequency of the currents in the secondary is high, the reactance in the path of high inductance is so large as practically to prevent any considerable current from flowing in this path, thus causing nearly all of the current generated in the secondary to pass through the high-resistance path. As the speed of the machine rises, the frequency of the induced currents, which is proportional to the slip, decreases, thus correspondingly diminishing the reactance due to self-induction, and so causing a greater portion of the induced currents to pass through the path of high resistance. When the speed of the motor has risen sufficiently, the frequency of the secondary currents is so low that the counter e.m.f. of self-induction in the inductive path is greatly reduced. Then nearly all of the current

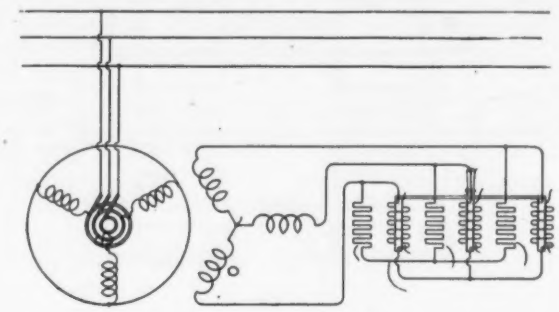


FIG. 1.—ZANI METHOD.

will flow through this path of low resistance. In order to further increase the variation of the reactance, additional means may be employed, for instance, the reluctance of the magnetic circuit may be varied (Fig. 1).

A patent was granted on August 4 to Mr. Henry G. Reist, of the General Electric Company, for an improvement of the method by which the resistance is inserted at starting in the secondary of an induction motor is cut out automatically by centrifugal force. The inventor uses a plurality of independent switches mounted on the secondary and arranged to be actuated independently and at different times by centrifugal force, for the purpose of cutting out the starting resistance step by step as the speed increases. The construction of the switch is also a novel feature of the invention.

A patent was recently granted to Mr. T. J. M. Girault, of Paris, France, for a method of starting in which the terminals of the phase windings of the secondary are connected to the primary of a transformer, the secondary windings of which are closed through variable resistances, which are gradually changed (Fig. 2). The advantages for this arrangement are that the use of large currents is avoided, and that it is unnecessary to use lengthy cables of large cross-section if the controller is at some distance from the motor. A patent for another method of starting was recently granted to the same inventor (Fig. 3). In this the arrangement consists essentially of two

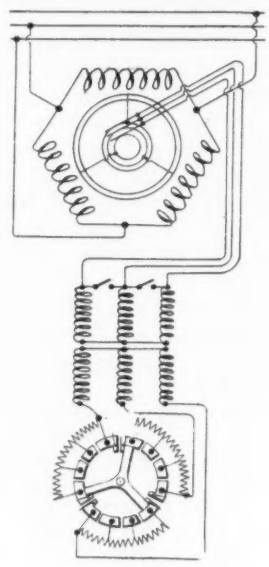


FIG. 2.—GIRAULT METHOD.

motors, the "principal" motor and an "auxiliary" motor. The secondaries of both motors are in series, while the primaries are so arranged as to exercise on the common secondary circuits a concordant action when the motor is working at normal speed. The rotors of both motors are connected mechanically so as to insure the same slip relatively to the stators. When the motor is started, only the primary of the principal motor is excited, while the primary of the auxiliary is open. The auxiliary motor then acts as a strong self-induction coil, and the current in the secondary is, therefore, small.

[5] Maxwell remarks that this should be 1772.

The primary of the auxiliary motor is then gradually more and more excited.

A novel solution of the starting problem is offered in a patent granted August 4 to Messrs. Walter Langdon-Davies and Alfred

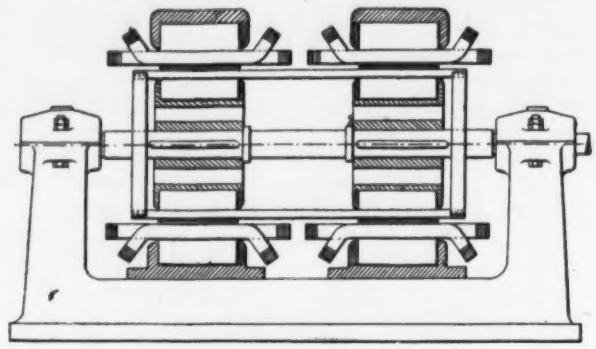


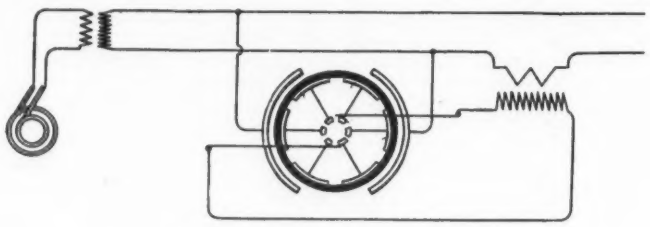
FIG. 3.—GIRAULT METHOD.

Soames, of Surrey, England. The motor is started and brought up to about full speed without the use of the winding on the secondary. The core of the secondary is made of solid brass or wrought iron or steel, of sufficient thickness to afford a path of high resistance for Foucault currents set up within it. On the other hand, the windings on the secondary have a high conductivity, so that when the motor has run up to full speed and the circuit of the windings is closed, there is small slip and but a small current flowing in the solid body. Very little heat is said to be generated in the solid body of the secondary when running at full speed.

As single-phase induction motors do not start from rest, it is usual to provide, in addition to the main single-phase winding, a starting winding in which the phase of the current is different. This starting winding is intended to be used only in starting, and if the attendant forgets to disconnect it after full speed has been reached, the motor will operate inefficiently, and the starting winding may burn out. To prevent such mistakes of the operator, Mr. A. R. Everest, of Lynn, Mass., has devised a starting switch for which a patent has been granted to him on August 4. This switch has "starting" and "running" positions, and when it has been moved into its starting position and is then released, it will be automatically moved into the running position.

Electrostatic Motor.

A patent has recently been granted to Prof. Elihu Thomson, of Swampscott, Mass., for an electrostatic motor for very light work, such as the driving of the recording mechanism of wattmeters. It may be operated under very high voltages and may be very cheap of construction, as it does not involve the winding and core system of the ordinary electromagnetic motors. It has two elements quite analagous to the potential and current coils of the operating motor of an ordinary Thomson wattmeter. The one element of the electrostatic motor is connected across the mains and may be assumed to be stationary; it consists in the case of a single-phase system



THOMSON ELECTROSTATIC MOTOR.

of two metallic plates, placed opposite to one another and facing the outside of a cylindrical hard-rubber drum, which is between them. Two metallic plates are thus charged electrostatically to the potentials of the two opposite mains.

On the inside of the hard-rubber drum a series of equidistantly-spaced metallic plates is mounted which are insulated from each other and form the second element or the armature of the motor. These plates are connected to a commutator on which bear two brushes in series with the supply circuit, thus corresponding to the series coils of an ordinary wattmeter. The drum is movable about its axis. When the circuit is closed on the two elements, the drum will rotate, provided the brushes bear upon the commutator segments in an angularly displaced position with relation to the field plates. The charge received from one side of the circuit acts repulsively upon one of the armature plates and attractively upon the other; after a definite range of movement sufficient to bring under the brushes a new pair of commutator segments, this attractive and repulsive effort is transferred to an adjacent pair of armature plates, and thus the rotation of the movable element is maintained so long as the circuit remains closed. Transformers may, of course, be interposed in the connections of the supply circuit with the two elements of the motor.

Some Tests of Recording Wattmeters.

By Ingwald A. Rosok.

In some tests of several makes of recording wattmeters, the connections and methods employed were in all cases as follows: The ammeter or series coil of the portable wattmeter was placed in series with the meter under test, care being taken in case of the portable wattmeter to insert it on the service side of the meter. The voltmeter or shunt coil of the portable wattmeter, or both in case both a voltmeter and a portable wattmeter were used, were connected in multiple with the shunt coil of the meter. Runs were then taken beginning with the smallest loads at which the meter would move and increasing them with each successive run until 50 per cent. overloads were reached. The results were plotted on co-ordinate paper laying off the load as found by the portable wattmeter or ammeter and voltmeter as abscissæ and the percentage of load registered by the formula,

$$Watts = \frac{3{,}600 \times constant\ of\ meter \times rev.\ of\ disc}{Seconds\ of\ run}$$

as ordinates. The resulting curves then showed the accuracy of the meter under all loads and conditions.

When leading or lagging currents were used an ammeter, a voltmeter and a portable wattmeter were connected in the circuit, since it in all cases was desirable to know the power factor. This was obtained by dividing the reading of the portable wattmeter by the product of the voltmeter and ammeter readings, which gives the power factor in decimals.

The running efficiencies of the meters were determined by finding the I^2R losses in the field and armature, the sum of which gives the total watts lost. The total number of watts passing through a meter minus the watts lost in the meter divided by the total watts gives the running efficiency, or

$$Running\ Efficiency = \frac{Total\ Watts - Watts\ Lost\ in\ Meter}{Total\ Watts}$$

It will thus be readily seen that in order to have high efficiency a meter must have a large impedance in its shunt coils and a small resistance in its series coils. In most of the meters tested the running efficiencies at loads of .05 of their rated capacities were found to be about 95 per cent., at .1 about 97 per cent., at .2 nearly 99 per cent., and at full load about 99.5 per cent. On overloads the running efficiencies were generally smaller than at full load.

The all-day efficiencies were obtained by finding the number of watt-hours lost in 24 hours when the meter was carrying a full load for different periods per day. The watt-hours lost in the meter subtracted from the total watt-hours passed through the meter divided by the same gives the all-day efficiency, or

$$All\text{-}day\ Efficiency = \frac{Total\ Watt\text{-}hours - Watt\text{-}hours\ Lost}{Total\ Watt\text{-}hours}$$

Curves were then plotted with watt-hours as abscissæ and percentages of loads registered as ordinates. These curves rise more slowly than the running efficiency curves, and considering five hours an average period of full load, the efficiencies were found to vary from 98 to 99 per cent., an average being about 98.5 per cent. This

is about 1 per cent. less than the average full load efficiencies, the difference being due to the large number of watt-hours lost in the shunt coils of the meters at no load.

The running performances of the meters under different non-inductive loads varying from zero to 50 per cent. overload were found as previously explained. Most of the meters tested were new from the factories and these performances were, therefore, in all cases found to be very good.

Variations in voltages were found to have considerable effect on the direct-current meters with compensating coils. It was thus found that one 15-amp. meter tested ran 10 per cent. too fast on 1-amp. loads when the voltage was 10 volts above normal, and 10 per cent. too slow when the voltage was 10 volts below normal pressure. On meters without compensating coils changes in voltages of 10 per cent. or less had no noticeable effect. Of the induction meters tested only one was much affected, the performance of the others being but very little changed. The meters affected ran in all cases too fast on high and too slow on low voltages.

Different frequencies affected all of the induction meters noticeably. It was thus found that several of the meters tested which ran correctly on 60 cycles, ran from 5 to 10 per cent. slower when tested on 40 cycles and from 2 to 6 per cent. too fast when 80 cycles were used. The ampere-hour meters were very little affected and the meters with commutators were not affected at all by changes in frequencies.

Inductive loads were found to affect meters with commutators considerably, lagging currents making them run too fast and leading currents too slow. The errors for power factors of 80 were found to vary from 1 to 4 per cent. from the non-inductive load readings. On smaller power factors the errors were greater. Thus, for a power factor of 60 the error in one meter tested on full load was found to be as much as 12 per cent., while in others it varied from 5 to 15 per cent., and in one meter it was found to be over 20 per cent. The errors when leading currents were used were found to be a little greater with the same power factor and load than with lagging currents. The induction meters were not affected noticeably under power factors of 60 or more. With smaller power factors, however, they all ran more or less too fast, except one which was oppositely affected, it being made to run too slow.

All meters would run too slow if they were not kept clean and had their pivots and jewels in the best of condition. It was thus found that an old meter tested which ran much too slow was improved 5 per cent. by changing its jewel and pivot, and it was improved 3 per cent. more by polishing its commutator and cleaning its integrating train, making it run nearly correctly on full load and start on a much smaller load than before.

The effect of not having the meters installed level was quite marked on small loads. It was thus found that all meters tested would run from 3 to 8 per cent. too slow on loads of one-fifth of their rated capacity when inclined 10°.

Compensating the meters for friction makes them start and run on much smaller loads than when not compensated. The latter, however, were found to be very little affected by vibrations, while the former were considerably affected, some of them also being made to creep on no load.

Subjecting a meter to short-circuits has the tendency to weaken the retarding magnets and make it run too fast. Thus one meter tested ran 3 per cent. faster, having blown two 10-amp. fuses in a fuse block having a distance of one inch between binding posts. All the direct-current meters tested were more or less affected by short-circuits. Those meters having their leading-in wires at the top were, however, much less affected than the meters which had their leading-in wires at the bottom. Induction meters having iron shields were not affected by short-circuits. Large masses of iron placed near the meters made most of those without iron fields run too slow, but did not affect those having iron fields. Different temperatures, atmospheric pressures, humidity, etc., affected one type of ampere-hour meters considerably, but had no noticeable effect on any of the other meters tested.

Aging has considerable effect on most meters. Thus two meters were installed new from the factory in a place where there was some vibration. After three months' service they were found to run nearly 3 per cent. slower than when installed. Several other meters tested for aging showed similar results. Thus a new 25-amp., 220-volt, 3-wire meter ran before installation 7 per cent. too fast on 1-amp., .9 per cent. too fast on 20-amp., and 1.1 per cent. too fast on 30-amp. loads. After having been in service three months in a place free from vibrations it ran 15 per cent. too slow on 1-amp., 1 per cent. too slow on 20-amp., and 3 per cent. too slow on 30-amp. loads.

A 10-amp., 100-volt, 2-wire compensated wattmeter tested before installation, ran correctly on 3-amp., 1.4 per cent. too fast on 3-amp. and 8 per cent. too fast on 8-amp. loads. After three months' service it would not run at all on 5-amp. loads; on 3-amp. it ran 2 per cent. too slow and on 8 amp. it ran 1 per cent. too slow.

Nearly all induction meters will start on smaller loads than meters with commutators. It was thus found that some of the induction meters tested would run fairly correctly on less than 12-watt loads.

Several tests were made in order to compare the performance of meters with commutators on alternating and direct currents, and it was found that most of the meters tested would run with exactly the same accuracy on alternating as on direct currents.

Leblanc Rectifying Transformer.

Two interesting patents were granted on June 2 to Mr. Maurice Leblanc, the well-known electrical engineer and inventor of Paris, France. The original application, filed on January 4, 1901, was later divided and two patents granted, one for a "transformer," the claims referring to the apparatus; the other for a "method of shaping rotary fluxes and operating transformers," the claims referring to the method. The latter patent is assigned to Mr. George Westinghouse.

The fundamental principle of the invention is that by means of "compensating windings" Leblanc is enabled to shape a rotary complex magnetic flux at will, so that certain predetermined components are entirely suppressed; it is thus possible to suppress all but a single component and to obtain an exactly sinusoidal rotating flux of two branches. As this is of fundamental importance, it may be explained somewhat more in detail.

If an iron ring about which circuits are wound is supplied with polyphase currents, a rotating magnetic flux is produced which is in general of a compound character. If we consider the flux at a given moment, as though it were fixed, and examine it from point to point of the ring, then it is a function of the position of the point

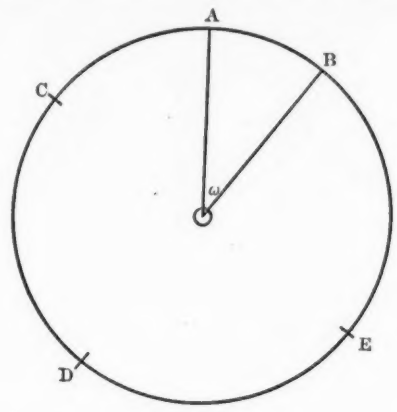


FIG. I.

on the ring. If we assume, as in Fig. 1, a fixed radius, $O\,A$, any point B of the ring is determined by the angle, w, which the radius, $O\,B$, forms with the fixed radius, $O\,A$, and the flux, Φ, at any point is a function of w; moreover, it is a periodic function because it attains the same value each time the angle, w, is increased by 2π. According to Fourier's theorem, it may, therefore, be represented in form of the following series:

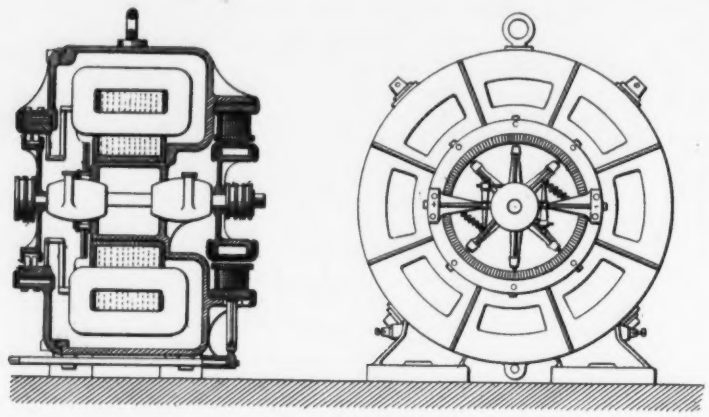
$$\Phi = \Phi_1 \sin (w - a_1) + \Phi_2 \sin (2w - a_2) + \ldots + \Phi n \sin (n w - a_n) + \ldots$$

This shows the "compound" character which the magnetic flux at a given moment has in general. What Leblanc accomplishes by means of his "compensating windings," is to suppress all terms of the series with the only exception of the first one. The flux thus obtained, $\Phi = \Phi_1 \sin (w - a_1)$, is a "pure sinusoidal flux of two branches." If we assume the angle, $A\,O\,B$, to be a_1 in Fig. 1, the flux has the value zero at the points B and D, it is a maximum at point C and a minimum at point E. Or we may start from point p and pass along the two branches, $B\,C\,D$ and $B\,E\,D$; then, beginning from point B, the flux gradually increases in both branches, ac-

cording to a sine law, passes through a maximum at *C* and *E*, and then decreases again.

Now, such a pure sinusoidal flux of two branches is required for the production of a strictly constant and uniformly rotating magnetic field. What Leblanc essentially accomplishes by means of his compensating windings, is, therefore, to screen out all the disturbing elements of the given flux of his apparatus and shape it so that a constant uniformly rotating magnetic field is obtained.

While this result may be applied for various purposes, its most important application is to rectifying transformers, in which polyphase or single-phase currents are transformed into direct current by connecting the secondary windings to the segments of a commutator. These secondary windings are usually embedded in iron and the e.m.f's of self-induction of commutation are so great as to make commutation practically impossible. By the use of Leblanc's compensating windings, however, regardless of the sudden change of current during commutation by the short-circuiting of the coils, the



FIGS. 2 AND 3.

e.m.f's induced in the successive coils correspond to a symmetrical polyphase system. It is thus possible to commutate a closed magnetic circuit transformer without meeting any excessive e.m.f. of self-induction.

A cross-section of the rectifying transformer of Leblanc is shown in Fig. 2. The central part of the apparatus is a stationary trans-

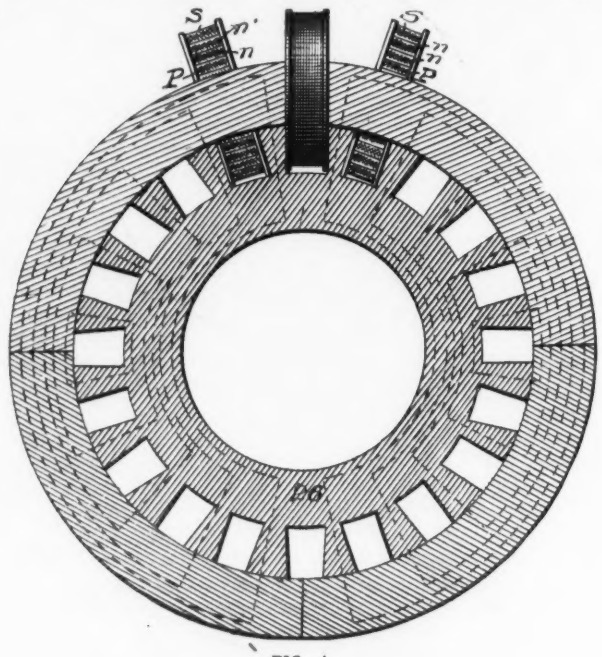


FIG. 4.

former ring, which is separately shown in Fig. 4. At the left hand of the transformer ring, in Fig. 2, there is an annular stationary commutator; within it a spider rotates, carrying brushes whose outer faces make contact with the inside surface of the commutator segments. At the right hand of the transformer ring there is a two-phase alternating-current motor which is mounted on the same shaft as the spider for the brushes at the left end, and serves for rotating them. The field magnets of this motor are mounted on a yoke which is rotatably mounted within an annular bearing, so that the field magnets are adjustable circularly. By shifting the magnets, the same result is obtained which in the ordinary case of a rotary converter is obtained by shifting the brushes.

The front elevation of the apparatus is shown in Fig. 3; the annular commutator is seen and inside the spider with eight arms, carrying the brushes. The first, third, fifth and seventh arms are connected to one slip ring; the second, fourth, sixth and eighth to another slip ring. These two slip rings are shown in Fig. 2. Fig. 3 shows how these two slip rings are connected by two brushes to the binding posts, + and —. These are the terminals of the direct-current circuit of the rectifying transformer. The alternating-current terminals are displaced around the circumference of the apparatus in a symmetrical manner.

The number of pairs of poles of the two-phase motor is equal to the number of groups of commutator segments. To the field system of the two-phase motor a magnetic shield is secured, of the well-known Hutin and Leblanc type; its function will later become apparent in the discussion of the conversion of single-phase currents.

The mechanical construction of the ring core of the transformer is shown in Fig. 4, while the electrical connections are diagrammatically indicated in Fig. 5. It will be seen that the lines of magnetic force lie almost wholly within iron. In the present case the ring core is provided with 20 bobbins, each composed of four separate coils; the inner coils, *P*, are the primary windings of the transformer, the outer coils, *S*, are the secondaries, the intermediate coils, *n* and n^1, being the compensating coils.

The commutator has four groups of 20 segments each, numbered

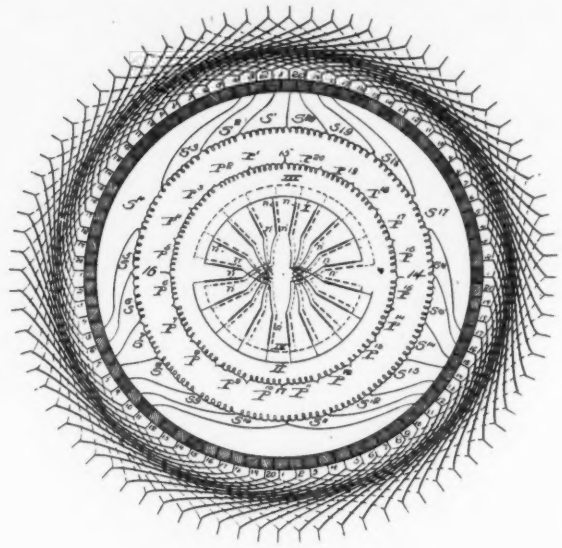


FIG. 5.

consecutively 1, 2—20; in general, like segments of the four groups are electrically connected as indicated by the wires on the outside of the commutator in Fig. 5. The 20 secondary coils, *S*, are connected in series and each of them is electrically connected at one end with the commutator segments bearing the corresponding number. The 20 primary coils, *P*, are also connected in series. The terminals of the two-phase current leads are at the four points, 14, 15, 16, 17, which are 90° removed from each other.

The arrangement of the two sets of compensating coils, *n* and n^1 (diagrammatically indicated inside the circle formed by the primary coils in Fig. 5), and their operation are the principal novel feature of the transformer. The one set, *n*, is the "sine compound compensating circuit" (indicated by full lines), the other set, n^1, the "cosine compound compensating circuit" (indicated by broken lines). As shown in Fig. 4, each slot of the ring contains one coil of each set, the number of turns at the point *x* of the ring being determined according to the two equations,

$$n_x = c \sin \frac{2\pi}{2K} x,$$

$$n^1{}_x = c \cos \frac{2\pi}{2K} x,$$

where *c* is a constant and $2K$ the number of slots, which is 20 in

the present case. The number of turns at each point is, of course, determined by the distance from an arbitrary zero point, $x = 0$, for instance point A in Fig. 1; at this point the sine compensating coil has no turns at all.

The method of interconnection of these coils is shown in Fig. 5. The sine compensating circuit is composed of a network of K parallel branches, each branch containing two coils (n) in series, the two coils being displaced by 90°; the two sets of ends of these K parallel branches are connected to the rings, I and II, respectively. The interconnection of the cosine compensating coils is analogous; the ends of the K parallel branches are here connected to the rings, III and IV, respectively.

Now we may assume that we have a pure sinusoidal flux of two branches which, at a certain moment, is zero at the points B and D in Fig. 1, as discussed in the introduction of this article. We may also assume that the point A is the zero point from which the number of turns of the sine compound compensating coils is determined, according to the equation just given. Then it can be shown by mathematical analysis that the rotating sinusoidal flux at the moment when it is zero at B and D, induces in each one of the K parallel branches of the compensating sine circuit the same e.m.f., and this e.m.f. is proportional to the angle w between $O A$ and $O B$. Hence the rotation of the sinusoidal flux produces at one certain instant zero e.m.f. in every branch; at any other moment there will exist an equal e.m.f. in each of these parallel branches and in the same direction in all, and this e.m.f. is measured by the sine of the uniformly increasing angle, w, which represents the velocity of rotation of the sine flux. The analogous result may be proven for the cosine compensating circuits, but in this case the e.m.f. in any branch is proportional to the cosine of the angle w.

If the coils I and II are not connected to each other, nor the coils III and IV to each other, then the rotation of the pure sine flux in the iron core will generate no currents of any kind, either in the compensating sine circuit or in the compensating cosine circuit. There will simply be generated a series of equal and equally directed e.m.f's in the parallel branches of the compensating sine circuit, which means that no current will flow from any one of these branches to any other of these branches (for the same reason that no current flows when two galvanic cells of equal e.m.f. are connected one against the other). A similar remark applies to the compensating cosine circuit.

If, however, the rings I and II are connected to two terminals of the two-phase motor, shown at the right hand of Fig. 2, and the rings III and IV to the other two terminals of this motor, two quarter-phase currents will be supplied to the motor so that the energy for driving the motor is derived from the compensating coils. But there will still be no flow of current from any one of the K compensating sine branches to any of the other K compensating sine branches, and the balance or equilibrium of the system will not be disturbed.

Assuming now that there is no external connection between the terminals I and II and between the terminals III and IV, it is manifest that the uniform rotation of a simple sine flux in the iron ring will have no effect on the compensating circuits, and the compensating circuits will have no effect on the uniformly rotating sine flux; each will exist precisely as if the other were not present. On the other hand, it can be shown that any other type of flux than the uniformly rotating simple sine flux will cause the generation of e.m.f's in the compensating branches which will no longer be equally directed, hence currents will flow from one branch to another. For a simple sinusoidal flux of two branches the compensating branches behave like open circuits, while for a flux of more than two branches the compensating branches short-circuit each other. The compensating circuits will, therefore, act as magnetic screens for all types of fluxes in the iron ring, except the simple sine flux, and will squeeze out and destroy these fluxes; but the simple sine flux will be allowed to move in the ring just as if the compensating circuits were not present.

This represents the solution of the general problem. It is of interest to give the application which Mr. Leblanc suggests for the special case of the transformation of single-phase currents to direct current. In discussing this problem Mr. Leblanc makes use of the resolution of a single-phase field into two revolving fields, which is often used in the mathematical discussion of single-phase current phenomena in European text-books. As can be easily seen, a single-phase flux is mathematically equivalent to two equal rotary fluxes, revolving with equal velocities in opposite directions. The effect of Leblanc's compensating windings in this case is to obliterate all but the pure sine or two-branched components of these two fluxes, revolving in opposite directions.

Now it becomes necessary to obliterate one of these two rotating fluxes. The scheme by which Leblanc claims to accomplish this is to connect the compensating circuits of the transformer to the armature circuits of his synchronous two-phase motor, the field circuits of which are supplied with direct currents, and to the field poles of which a magnetic shield of the Hutin-Leblanc type is applied. The armature circuits of the motor will then be the seat of e.m.f's corresponding to two oppositely rotating magnetic fields. One of these fields will move in a direction opposite to that of the rotation of the armature with a velocity equal to that of the armature, and will, therefore, be stationary in space. It will not be affected by the magnetic screen in the motor. The other rotating field will move with reference to the armature and in the same direction as the armature with a velocity equal to that of the armature. It will, therefore, move in space—i. e., with reference to the magnetic shield—at a velocity equal to twice that of the armature. The magnetic shield will, therefore, consume and thus obliterate this rotating field and the other one is alone left in the armature circuits of the motor. The compensating circuits will then also be the seat of currents corresponding to a single rotating field moving in a given direction.

Transformer House Dynamited at Idaho Springs, Colo.

The accompanying illustration shows the result of a dastardly attempt to destroy life and property made at the Sun and Moon mine, near Idaho Springs, Colo., on the night of July 28, as previously noted in these pages. The evident plan had been to blow up the shaft house, transformer plant and compressor house of the

DYNAMITED PLANT, IDAHO SPRINGS.

mine with two kegs of powder, but the discovery of the dynamiters by the watchman, who saw them light the fuse, caused the men to leave all the powder at the transformer house, which was completely wrecked, as the picture indicates. At the right in the illustration is seen the compressor building and in the distance with the two stacks is the shaft house. At the time of the explosion there were 14 men at work underground in the mine and four men above, and had the shaft house been destroyed, there undoubtedly would have been considerable loss of life. As it was no one was injured except one of the dynamiters, who was killed by the explosion. This man had been known as a strong sympathizer with the union which was on a strike at the mine.

The transformer house was a frame building sheeted with steel and contained three General Electric 75-kw, oil-cooled transformers. Current was received from the plant of the Union Light & Power Company at Georgetown, 13 miles distant, at 10,000 volts, three-phase, 60 cycle and was stepped down by these transformers to 440 volts. The power was used to operate two 100-hp General Electric induction motors that drove air compressors for the mine.

The transformers shown lying on their sides were ruined. The force of the explosion knocked them over and the oil caught fire, completely destroying the insulation. The casing of one transformer was cracked and the other one had a hole blown in it. The transformers left standing were found uninjured, a fact that is somewhat remarkable when the force of the explosion and the heat of the burning oil are considered. The oil switch of the transformers was ruined, as was the wiring in the station. Immediately in front of the standing transformer is seen the bank of lightning arresters that had been mounted above the transformers.

A similar attempt was afterward made to destroy the water power plant of the Union Light & Power Company at Georgetown, but it resulted unsuccessfully.

New Telephone Patents.

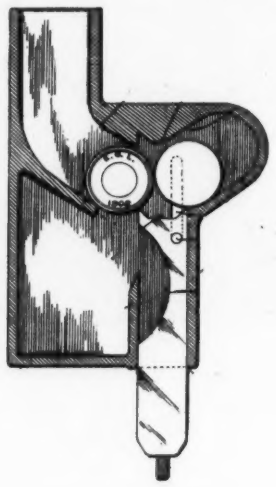
SUBSCRIBER'S MESSAGE REGISTER.

Where measured service is the standard for telephone contracts, the burden of keeping record of calls is no small task, and where the ticket system is used, i. e., where the central office operator writes a check for each call, the average load per operator is reduced about one-third. As a means of obviating this drag, many different sorts of message registering devices have been brought forward, one of the simplest being that wherein a counter is mounted at the subscriber's premises.

Mr. G. A. Long has recently patented a very compact device of this kind, his patent being assigned to the Gray Telephone Pay Station Company. The shape of this register is not far different from the push socket switch, the operating plunger projecting through it increasing the resemblance. Within the case are a rachet counter and a gong so connected with the plunger that the depression of this latter both operates the counter to score 1 and sounds the gong to notify the operator that the count has been made. A hammer latch and a damper associated respectively with the gong hammer and the gong prevent any possibility of a false or premature signal.

TELEPHONE LOCK.

Another method of keeping count of calls is to require prepayment for the individual calls, the telephone lock being a device which prevents the operation of the hook switch until the proper coin has been deposited. Such locks are extremely simple mechanically, the latest



TELEPHONE LOCK.

design having but two moving parts. This is the invention of W. H. Scott, of St. Louis, whose patent has been assigned to the Controller Company of America. The accompanying figure shows a section of the lock just after a coin has been deposited. Normally the locking disc (to the right) rests on the shelf shown below, thus restraining the bolt against any upward thrust from the hook switch lever, shown in section at the bottom of the cut. Under the conditions shown the bolt is free to rise, pushing the coin and disc into their respective slots. The cut-away portion of the bolt then rises so that it forms for the coin a runway leading into the coin box. The disc is then retained in its slot until the bolt again descends.

TWO-LINE SWITCH.

Under the title "Rotary Extension Bell Switch," Mr. G. E. Coils has patented a rotary switch which can effectively control two lines without the necessity of other switching apparatus. The particular combination of circuits in the inventor's mind is that of two lines terminating at a common point and desiring connection with that point at times independently and at times simultaneously. The rotating switch has contact rings and points to connect the main telephone set to either or both lines at will, always connecting an extension bell to the idle line.

BURGLAR ALARM ATTACHMENT.

Mr. Solomon Schwarzschild, of Rochester, has produced another burglar alarm attachment for telephone lines. The novel features embrace time switches limiting both the setting and turning off of the alarm attachment at such times as the protected premises are to be legitimately entered. The present patent covers the combination of the alarm devices with the telephone circuit.

Radium, Heat and Cold.

According to a special cable dispatch of August 15, another discovery as to the properties of radium has been communicated this week to the French Physical Society by Professor Curie. It was only in March last that eminent men of science refused to accept the statement so irreconcilable to scientific experience that radium possesses the property of maintaining a temperature at a point three degrees higher than that of its surroundings. But the fact that, in addition to the marvellous radio-active properties already described, radium has this unique and unprecedented power of the emission of heat has been established beyond the possibility of question. Strenuous efforts have been made to obtain accurate measurements of this heat production and determine the effects of external conditions in promoting and retarding it.

Professor Curie found that heat emission remains unchanged through a very wide range of temperature, there being no perceptible variation at the temperature of a summer day, or that of liquid air, but if a downward stride is taken from the temperature of liquid air to that of liquid hydrogen, radium shows that it is not always unaffected by the external temperature.

And here comes the amazing new fact that the change in the rate of heat emission of radium within the comparatively short distance of absolute zero is in exactly the opposite direction to what might be expected in view of the effect of low temperatures on ordinary chemical action, for at the temperature of liquid hydrogen the heat emission of radium, instead of being reduced, is augmented. In simple language, the substance which does not change its heat at all temperatures, from that of an ordinary room to that of liquid air, gives out a greater heat when subjected to the greatest cold that scientists have yet reached.

These experiments with liquid hydrogen have led to the curious discovery that freshly prepared salt or solution of radium has a comparatively feeble power of giving off heat at all temperatures, but the power steadily increases for about a month, when it reaches its minimum activity, which it then maintains apparently indefinitely. These remarkable results have failed to throw any light upon the process whereby radium maintains a constant emision of heat radio-activity.

Municipal Steam Turbine Plant, at Anderson, Ind.

An interesting municipal electric lighting plant enterprise is under way at Anderson, Ind., and marks the second introduction of the steam turbine in American municipal power plant service. The city of Anderson has for some years operated an electric light plant in connection with the city water works, located near White River. The electric installation is housed in a separate building approximately 50 ft. x 100 ft. adjacent to the water works plant, whose boilers furnish the steam power necessary for the operation of the electric light plant. The present lighting equipment comprises two belted generating units, but the increasing demand for light and power renders the available capacity inadequate to carry even the present load at times, resulting in a severe overloading of the entire equipment. In order to secure immediate relief from these conditions and avoid the necessity of erecting additions to the power house, West--

inghouse steam turbine generating units have been selected for power extensions. At the present time two 400-kw units will be installed, together with one 20-kw exciter, direct-connected to a Westinghouse standard engine and a complete switchboard equipment.

As the result of the employment of turbines in this plant it has been found possible to install a complete boiler plant in the electric light building, thus rendering the operation of the lighting system entirely independent of the water works system. The new boiler plant consists of three 310-hp Sterling water tube boilers equipped with Roney mechanical stokers. The boilers will not be arranged for superheat, but will supply saturated steam to the turbines at 150 pounds pressure, all condensation being returned to the boilers by a steam loop and Holly gravity return system. The turbo-generators will furnish three-phase currents to the lighting power and distributing system at a frequency of 60 cycles and at 2,200 volts pressure, no step-down transformers being used. The turbine equipment will operate condensing as the plant is located near the river bank, where condensing water is available. Surface condensers will be used and the condensation from the turbines will be returned directly to the boilers, as the exhaust is entirely free from oil.

An interesting feature of the turbine installation is brought out by the fact that by replacing the belted units with turbine-driven units, sufficient space is made available for the installation of the complete boiler plant, together with an additional turbine unit and the necessary boilers at such times as the future demands upon the plant require this extension. Mr. E. R. Vincent, M. E., of Indianapolis, Ind., has been retained by the city of Anderson as consulting engineer, and the installation is under his general supervision.

Recent Electrochemical Developments.

REDUCTION OF NITRO AND AZO COMPOUND.

The employment of a surprisingly large number of trained chemists and electrochemists for pure research work is the principal means by which all the larger chemical works in Germany endeavor to retain their leading position in the world in the field of organic chemistry. Electrolytic methods for oxidation and reduction of organic compounds form one of the favorite subjects of this systematic research work, and the following three patents on the reduction of nitro and azo compounds are representative of the work being done. These were issued August 11 to Mr. Max Buchner, assignor to C. F. Boehringer & Sochne, of Mannheim, Germany. The anodic and cathodic compartments are, of course, separated from each other to obtain a high current efficiency. The nitro or azo compound is held in solution or suspension in the cathode department.

The reduction formerly was assumed to require an acid solution and has been shown to go on well in the presence of tin ions. The use of metallic tin is, however, of commercial vaue only if a comparatively small quantity of tin can be used over and over again in the reduction of comparatively large quantities of the starting materials. One of Mr. Buchner's patents refers to a method of carrying on the reduction in such a way that the recovery of the tin is simple. It is based on the fact that tin may be electrolytically precipitated even from strong acid solutions of tin in hydrochloric acid (which remain at the end of the reduction of the nitro compound), if the reducing process is so conducted that the tin used is converted only into stannous chloride and exists in the solution as such, together with the resultant amines. A second patent refers to the use of chromium, lead, mercury, or iron instead of tin. The third patent refers to the reduction in an alkaline solution in the presence of copper, the reduction to amine being almost quantitative.

The facts ascertained by the inventor are somewhat surprising and unexpected in view of former investigations, especially of Elbs; they emphasize the fact that we still know really very little concerning some fundamental points of the mechanism of electrolytic action. In recent years it has become customary to "explain" by the term "catalytic action" all processes in which apparently inert materials have some effect on the final result, but in reality this term only serves to conceal our ignorance of what really happens.

ELECTROLYSIS OF FUSED SALTS.

In the electrolysis of fused substances which are externally heated, a great difficulty is generally found in the rapid destruction of the containing vessel, especially of its bottom plate, which rests on the fire box. A patent was granted on August 11 to Mr. C. W. Roepper, of Philadelphia, for details of a mechanical construction of the fusion vessel, which enables one to easily and cheaply replace the heating bottom plate whenever it is destroyed. The fusion vessel is a rectangular metal box without bottom; the lower edges of these sides rest and fit on top of the side walls of the fire box. The top of the walls of the fire box are recessed for this purpose. The bottom of the fusion vessel is formed of a comparatively thin arched metal heating plate, D, which lies directly over the fire box, presenting its concavity thereto. It is supported upon its edges, which project between the lower edges of the sides of the fusion vessel and the recessed portion of the top of the fire box.

NICKEL PLATING.

In the early experiments with nickel plating great difficulties were experienced on account of the tendency of layers of electrodeposited nickel to peel off. This difficulty has now been more or less successfully overcome and various secret "dopes" are used by practical platers to get a firm deposit. A patent has been granted on July 28 to Mr. Thomas A. Edison for the following method by which a thin electrolytic deposit of nickel on iron or steel can be rendered firmly adherent. After completed electrolysis the nickel-plated pieces of iron or steel are brought into a non-oxidizing atmosphere, for instance of hydrogen, and heated to a temperature sufficient to weld the film of nickel to the iron or steel backing. A bright yellow heat is required for that purpose. The contact thus produced between the nickel and iron or steel is so perfect that sheets plated in this way can be formed into various articles by the drawing or stamping process without cracking or flaking the film.

PURIFICATION OF WATER.

The list of electrolytic methods of purification of water and defecation of sewage has been increased by another one for which a patent was granted on August 11 to Mr. Samuel S. Pridham, of Newark, N. J. The novel features are details of the mechanical construction of the cell and the use of electrodes of an alloy of magnesium and aluminum.

ELECTROLYTIC DYNAMO.

A peculiar application of the principle of unipolar dynamos for electrolysis has been patented by Mr. F. E. Elmore, of London, England. The dynamo and the electrolytic cells are in one apparatus and metallic conductors or rubbing contacts are avoided. For this purpose an electrical conductor with the electrodes at each end thereof, is moved in a magnetic field situated between the electrodes, the simplest arrangement being a circular conductor with electrodes concentrically arranged on it rotating in a circular field.

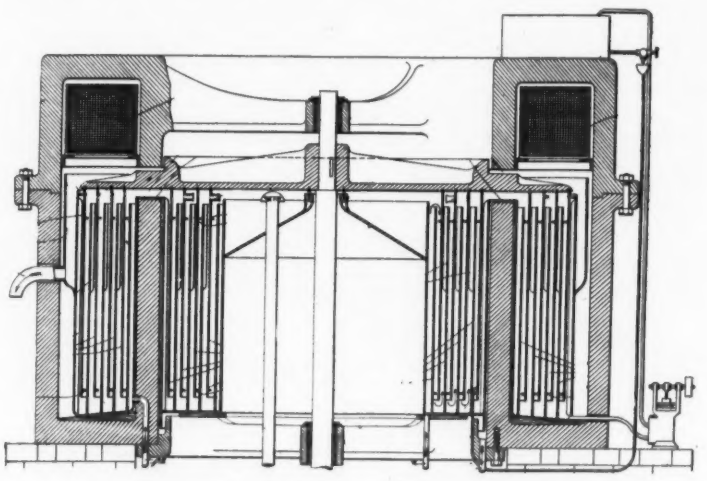


FIG. I.—ELECTROLYTIC UNIPOLAR DYNAMO.

The armature is a horizontal metal disk, revolved by a vertical shaft. The magnet is an annular box, constructed wholly of magnetic material and completely closed except that its inner wall is divided horizontally to form an air-gap through which the armature extends. The exciting coils are wound round the upper parts of the magnet. The lower part of the magnet contains an annular vessel and a similar vessel, of small diameter, is contained in the space enclosed by the magnet. Each of these vessels constitute an electrolytic cell, the two being in electrical connection through a continuous conductor passing through the air-gap, but insulated from the magnet

casting. The one set of electrodes are cylinders set on the bottom of each cell so as to partition it into a number of chambers. Into each such chamber there extends a like concentric cylinder, depending from the armature; the set represents the other electrodes. When the armature is revolved, current is generated and flows through the cells. The application of the apparatus for the electrolysis of brine for the manufacture of caustic soda and chlorine is described.

BATTERY INVENTION.

Mr. C. J. Reed has patented a new method of formation for storage battery plates. He first subjects a metallic lead plate to the action of hydrochloric acid gas in a closed receptacle, preferably in conjunction with an oxidizing agent, such as chlorine or one of the higher oxides of nitrogen; a layer of lead chloride is thus produced. The lead chloride is afterwards reduced to metallic lead, either electrochemically or by the reducing action of metallic zinc or some other suitable reducing agent; or it is converted directly by electrochemical action into lead peroxide.

Mr. A. F. Clark, of Philadelphia, has patented a method of manufacturing storage battery plates of that type in which the grid is formed under pressure; the object is to so form the gratings of the grid that they may be readily removed from the mold and be used with a special form of supporting separator. The details of the invention are of a mechanical nature. The separator forms what may be called an envelope which encloses the entire positive plate.

Messrs. W. Teto and J. W. T. Cadett, of Ashlead, England, have a new composition for use as a plastic or semisolid electrolyte in accumulators. It consists of powdered or precipitated lead sulphate moistened with dilute sulphuric acid of about the average strength used in storage batteries.

Mr. A. V. Meserole, of New York City, has patented details of mechanical construction of a battery in which the active material is contained in wafers of kidney form which are mounted on a pair of tubes. The objects to be thus attained are stated to be the utilization of a greater amount of active material and compensation for the expansion of this material.

BOOSTER FIELD EXCITATION.

Mr. Lamar Lyndon, of New York City, has patented some improvements of the field excitation of a booster when used together with a storage battery to absorb the fluctuations in the load. He provides the booster with balanced field coils influencing the booster to generate e.m.f. in opposite directions. Under normal conditions these coils are so arranged as to neutralize each other in their effect, so that the booster generates no e.m.f. The one booster field coil is connected across the line and wound to cause the booster to feed current out to the line. The other booster field coil is a shunt coil between the battery and the line and wound to oppose the battery discharge. The booster field is thus a differential field directly responsive to the voltage fluctuation at the battery terminals, and is thus in a measure responsive to load fluctuations in the line. Quite a number of modifications of this arrangement are described. Thus,

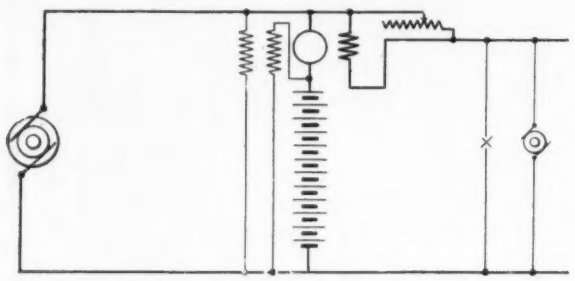


FIG. 2.—LYNDON STORAGE BATTERY BOOSTER SYSTEM.

in the adjoining diagram, an additional field winding for the booster is provided which is in the main circuit and influences the booster to feed additional current to the line. Further adjustment is possible by means of variable resistances, one being shown in the diagram in connection with the last named coil.

Two further patents have been granted to Mr. H. Halsey, of New York City, pertaining to the type of cell, the general character of which was noticed in our last issue. One patent refers to means for maintaining the movement of the electrolyte, the other to a receptacle for containing and gradually feeding a dipolarizing fluid to the electrolyte.

CURRENT NEWS AND NOTES.

SUBMARINE CABLE DAMAGE.—The West Indies were visited by a fierce and destructive hurricane last week. The hurricane demolished the cable hut, landlines, and office at Holland Bay, Jamaica, the landing place of the Porto Rico cables. Communication was restored by rejoining the cables on the beach, an operation of great difficulty.

TROUBLES IN KOREA.—Mail advices from Tokio say: "The trouble between the Korean authorities and the Japanese Railway Company, which is attributed to secret Russian action at Seoul, is approaching a climax. At the same time the Seoul electric railway, a United States concern, is having trouble. The line has been objected to by Koreans, and consequently scarcely any passengers are traveling. The United States Minister has claimed damages at the rate of $100 a day from the Korean Government in consequence of the lack of traffic.

WORLD'S DEMAND FOR TOOL-MAKING MACHINES.—The *Deutsche Industrie Zeitung,* in its issue of July 17, 1903, calls attention to a congress or convention of Germany's tool-machinery makers. Reports of those present went to show an increase of business in the Empire; but the orders were not large enough nor the prices satisfactory. The orders from the Government were not nearly as large as desired. Complaint was made against the custom of the large iron mills of contracting for machinery only on condition that part payment be made in the iron or steel products of the mills. Another evil complained of is the custom of the iron or steel mills of making their own conditions when contracting, instead of following, as formerly, well-established customs. In the matter of contracts in which it is provided that the tool makers take steel or iron from the mill, great abuses have crept in. The contract provides sometimes that fully 50 per cent. of the bill be paid in material. Inasmuch as the greater part of a tool-making machine's value lies in the labor expended on it and the most of the material is cast iron, the demand of the mill to be allowed to pay for it in its products seems unfair and unjust. It is thought that little can be done in individual or isolated cases, but that a combination of the machine builders might effect a reform. Reports made to the convention regarding foreign trade show a decline. In France everything was quiet, Italy offers little encouragement, Spain promises great things by and by, particularly for the marine. The United States, it was said, must be given up as hopeless because of its own development of machine making.

NIAGARA POWER FOR TORONTO.—The special committee appointed by the Toronto City Council to consider the question of electric energy has received a supplementary report from the City Engineer. Mr. Rust thinks the cost of plants to develop energy at Niagara for the use of Toronto and other municipalities would be between $4,000,000 and $6,000,000. In the neighborhood of 18,500 horse-power would be necessary to supply the city. After consulting with Mr. Alexander Dow of Detroit, the electrical expert, Mr. Rust, came to the following conclusion regarding the cost of energy per horse-power: "Assuming that it will be $10 per horse-power at Niagara, the cost delivered at the city limits would be $18.96, providing for 13,500 horse-power. To increase this 50 per cent., making it about 20,000 would bring the cost down to $16.48 delivered at the city limits. If the Toronto Railway Company will agree to take their power from the city over the same line, it would be reduced to $15.23 per horse-power. Taking the highest figure the cost per horse-power at the city limits would be $18.96. Adding distribution losses and the expense of distribution, this brings the total amount to $38.16. These figures show that the city should receive an average figure for power distributed sufficiently in excess of $38.16 per annum to prevent any possibility of loss. If they could find a market for 25,000 horse-power this estimate can be reduced to $33. Assuming that the power will cost an average of $38.16 per horse-power and comparing this price with the present rate charged in this city for electric light and power, a very large saving would be effected." Mr. Rust's opinion was that steam power in Toronto, as estimated from the cost at the city water works, cost about $60 per horse-power, and on that account a great number of customers could be had for the city power.

WIRELESS TELEPHONY.—It is reported that the Erie Railroad Company will equip one of its North River ferryboats and the Jersey City ferry terminal with the Collins wireless telephone system, of which details have been given, with illustrations, in these columns.

POLICE PATROL SYSTEM.—Police Commissioner Greene, of New York City, has made arrangements with the New York Telephone Company for a complete police signal system on the Island of Manhattan. The subject has been agitated for 15 years. To start with, there will be 661 telephones in iron boxes on poles, etc., at an annual cost of $20,855, inclusive of everything. Only policemen will carry keys. The boxes will be painted gray, and about 15 x 18 in. The service is to begin by October. Brooklyn has an older system in use.

ANOTHER WIRELESS NEWSPAPER.—The *Block Island Wireless* is the name of a little paper published daily on Block Island by the *Providence Journal.* The paper is issued every morning and contains a summary of each day's news, sent it through the De Forest system. In the past the people of New Shoreham and their hundreds of summer visitors have had to wait for news until the arrival of the afternoon boat on the day following the occurrence of any important event. Now they have a newspaper of their own. This is the first newspaper in the East entirely dependent on wireless telegraphy for its news, and the experiment is said to be satisfactory.

MONEY BY WIRELESS.—The Cunarder *Campania* has established a wireless money-order department. The office is open at all hours and there are no fees. Henry Robertson, a passenger on the trip that ended last week, found he had not enough money to pay the customs duties on his purchases abroad. Recalling that his mother was a passenger on the *Lucania,* traveling in the opposite direction, he sent her through the air a message asking her to pay the purser on the *Lucania* fifty dollars and send him wireless word to that effect. The money-order transfer between the two pursers was then easily effected.

EFFECT OF FREE TRANSFERS.—It is stated that the operating expenses of the Chicago Union Traction Company owe their largest increase to the universal transfer system imposed on them by the city of Chicago a year ago next October. Before this period the company used about 1,000,000 transfers monthly, whereas at the present moment 2,000,000 transfers or thereabouts are necessary to meet the large traffic over the company's lines. This statement bears out the report that Metropolitan Elevated traffic has been cut into 3,000 or 4,000 per day on account of this transfer system. Officials of the traction company state that most of the injury to elevated road traffic comes in the summer months.

SEPARATING MAGNETIC PARTICLES FROM WOOD PULP.—A patent issued August 11 to Mr. C. J. Reed describes an arrangement for the separation of magnetic particles from wood pulp. Two cylindrical soft-iron cores suspended in a tank have helical grooves in which are placed the magnetizing coils. Each of these is surrounded by a closely fitting brass cylinder, which revolves about its axis. At rest the iron particles would gather in helical lines corresponding to the grooves on the core; as the cylinders revolve, however, the particles in endeavoring to follow the line of greatest attraction are given a downward helical motion and finally drop off the end of the cylinder. In the tank are guides which cause all the pulp entering to come into contact with the cylinders before passing out on the opposite side.

THE SUPPLY OF EDISONS.—A special cable dispatch from Paris, as subjoined, advises that the supply of Edisons is not running out: "A young Brazilian to come before scientific circles in Paris is Señor Oswaldo de Faria, a youth of sixteen, who is solving problems which foiled electrical specialists. He has invented a regulator permitting the transformation of currents to regulate light with incredible ease and simplicity. This week the Brazilian Minister, a number of leading electrical and scientific authorities and engineers assembled in his mother's drawing-room and enthusiastically applauded his achievements. An apparatus utilizing current from the Champs Elysées central station produced a fixed light, propelled a four-horse-power motor and actuated a coil giving a 22-in. spark, besides charging accumulators rapidly." How wonderful!

TANDEM-MULTIPLE CONTROL OF INDUCTION MOTORS.—When the primary windings of an induction motor are connected in delta, the e.m.f. impressed on each coil bears the ratio of the square root of 3 to the e.m.f. impressed on the individual coils when connected in star. Since the torque on an induction motor is proportional to the square of the impressed e.m.f., it follows that the change of the primary windings of the motor from star to tandem connection results in increasing the torque of the motor three times. For a method of control of induction motors based upon this principle, a patent has recently been granted to Albert H. Armstrong. The application of this principle is especially useful in connection with the control of induction motors by the tandem-multiple system. When induction motors are operated in tandem, their torque is materially lower than that which they would have were they connected in multiple. By connecting in delta the primary windings of the first of the two tandem-connected motors, it is possible to more than counterbalance the inherent lessening of the torque due to the tandem connection.

IMPROVEMENTS IN TELEGRAPH INSTRUMENTS.—Three patents were recently granted to Mr. John C. Barclay, of New York City, for improvements in the construction of telegraph sounders, relays and repeaters. In the use of relays with magnets movable toward and away from their armatures, much trouble has been experienced from breakage of the armature or its pivots while the instrument is being adjusted. To prevent such breakage the inventor employs a novel location and arrangement of the armature with respect to the poles of the magnet, and provides a stop to limit the motion of the magnet towards the armature; for this stop the trunnion bracket is used, which has sufficient strength and solidity for the purpose.—In using ordinary main-line relays as sounders, their magnet is usually enclosed in a resonance box. Mr. Barclay has devised a new construction of the resonance box of such "box relays," in order to improve the sound and facilitate the adjustment of the instrument. He makes the resonance box relatively shallow, so that it encloses a portion only of the magnet; the box rests upon the wooden base of the instrument at certain points only; moreover, suitable sound-holes are provided and the resonance box is made of metal except the end carrying the anvil, which is of wood.—In the polar duplex repeater commonly used at present, a main-line polar relay is provided, the magnet of which is connected to the incoming line. This relay controls, by means of a local circuit and battery, a pole-changer arranged to connect a generator to the outgoing line and to reverse the direction of current therein with each operation of the main-line relay. It is quite evident that the whole operation will be condensed and simplified and the speed of the repeater increased if the main-line relay itself connects the generator to the outgoing line, and controls the polarity of the current in this line. Such a system, however, has distinct difficulties in construction, mainly on account of sparking. Mr. Barclay has devised a polar relay of this type in which there is little or no sparking, and which may be used as a main-line repeating relay without interference with its operation by sparking and with a considerable gain in speed of the system. By eliminating the local pole-changers at the repeater station, the variation of signals heretofore observed, due to imperfect adjustment of the pole-changers, has been entirely removed, and the quality of the signals greatly improved. The device in operation reduces the number of repeaters in a circuit one-half.

LETTER TO THE EDITORS.

Rotary Disks.

To the Editors of Electrical World and Engineer:

SIRS:—In an article printed in your issue of February 15, 1902, I described an arrangement of "Rotary Disks," and what follows is a description of a new experiment with the same, and conclusions concerning these. I used two arrangements of disks. One is a single shellaced mica disk on a short axle; the sparks from the secondary of an induction coil were made from slightly raised points under this disk to one side near the circumference. The other consists of two shellaced mica disks on the same axle about ⅜ in. apart. The axle in this case was a thin piece of steel about 1¾ in. long. The sparks were made near the circumference between the two disks. The disks are 2¼ in. diameter, and rotate in a horizontal plane in jewelled bearings. The spark length is generally ¾ in., reduced to ⅝ in. or less. Sometimes I have used 1½ in. reduced to 1¼ in.

The object in writing this is to answer the question whether a charge on a piece of mica in rotation as described moves with the rotation or remains at rest and slips on the mica. I will first give a simple experiment which appears to settle the above question.

I placed a small particle of sealing wax on the upper side of a disk not far from the circumference and noted what occurred when the disk was set in rotation by the sparks under it. I found that the particle of sealing wax remained nearly if not entirely at rest, when furthest away from the spark-gap, but when it approached near the spark-gap as the disk rotated, it began to dance, and when over the spark-gap, it sprang high up in the box containing the arrangement, and generally landed off of the disk.

It must be remembered that I was dealing with rapidly dissipating charges, but I can still distinctly recognize the fact that the charges on the disk were slightly shifted in the direction of rotation, and that there was constant slipping of the charges on the disk. An analogy is that of water poured on a revolving wheel, such as a grindstone, at the top of the wheel or on the side that has the upward motion. I have often noticed the slight shifting of the water forward on the wheel in such cases.

While I have no experiments to show whether the phenomenon would occur when the charges are of low potential, I have every reason to believe it would. The slipping and slight shifting of the charges on the rotating disks perfectly account for the rotations obtained from — to + when the disk is started from — to +, as formerly described. It must be remembered that there was nothing under the disks or near them, to which the charges could extend their lines of force and hold thereto.

BALTIMORE, MD. ALFRED G. DELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Motor-Starting Switches.—BATE.—A paper read before the Birmingham Section of the English I. E. E., with the discussion. The author points out the great divergencies that exist in the construction of switches, and proposes, in order to avoid misunderstandings and to encourage standardization, to follow the example set by the German Institution of Electrical Engineers, and to classify starters and starting resistances as follows: Class 1. Occasional use, where a sufficient interval is allowed between the times of use to permit the resistances to cool down to air temperature. This represents the majority of cases, and the author is of the opinion that the resistance should be able to carry the full load current safely for at least half a minute, and carry an overload of 20 per cent. of current—i. e., 50 per cent. of watts—for say 10 seconds. Class 2. Frequent use, where the interval is not sufficient to allow of complete cooling, or where the time taken in attaining full speed is unusually prolonged for any reason. Class 3. Continuous use would include speed regulators. The author considers the "absorption" type of wire resistance in which the wires are surrounded by cement, sand or other suitable material, not only the best but also the cheapest. This type is somewhat more difficult to repair than the radiation type is, especially if cement is used instead of sand, but this slight drawback is more than compensated by the protection of the wires from mechanical injury and from damp. If properly made, the absorption type stands overloads for a short time, just as well as the radiation type. As far as liquid resistances are concerned, the author thought that they offered many advantages for exposed situations and large powers. A slight drawback is the need of replenishing the liquid from time to time. To give satisfaction to the general user, the liquid starter must be provided with an overload and "no-volt" release. If a "no-volt" release cannot be used conveniently, the main double-pole switch must be interlocked with the resistance, so that the current cannot be switched on while the resistance is cut out. The author then discussed the methods of connecting the resistances with the motor. He points out the weaknesses of the method of connecting the armature to the starting lever, and to join both the main and the shunt magnet wires to the last or "full-on" contact of the resistance. The field is then excited when the main switch is closed, and the motor is started and stopped without demagnetizing the magnets. When the lever touches the first contact, the full torque is applied instantly to the armature, and this causes undue strain on the moving parts. A more serious weakness of this method of connection is that when the motor is at rest, with the starting switch in the "off" position, the magnet windings are not connected across the brushes, and if the main switch is opened, the kick of the magnets will be very likely to rupture the insulation of the field spools. In regard to switch work, the author advocated the same classification as that proposed for resistances.—Lond. *Elec.*, July 24.

Harmonics in Alternating-Current Machines.—GUERY.—A mathematical study on the principal causes of the production of harmonics and the means of preventing their production. The author deduces different conditions which must be fulfilled in order to get a voltage curve without appreciable harmonics. In the first place, a sinusoidal distribution of the inducing field along the air-gap is necessary, which may be obtained by giving the air-gap a variable length at the different points of the polar surface. In order to suppress the harmonic due to the slots of the armature, he suggests inclining them toward the radial line, so that the outer end of one slot is radially in line with the inner end of the next slot. To suppress the harmonics due to the armature current, it would be necessary to so construct the winding that the conductors of the same circuit are distributed according to the sinusoidal law over the periphery of the armature.—*L'Eclairage Elec.*, July 11.

REFERENCES.

Rules for the Testing of Electric Machines and Transformers.—DRUCBERT.—A very long article giving a summary of the rules adopted by the German Electrical Society, and a comparison with the American rules.—*L'Eclairage Elec.*, July 18, 25.

Speed-Reducing Gears.—ERECKY.—An illustrated description of a gear based on the principle of rolling friction, especially adapted for electric motors.—*Zeitsch. Oest. Ing. und Arch. Ver.*, July 24.

LIGHTS AND LIGHTING.

Heat Radiation of Incandescent Lamps.—FISCHER.—A long article, in which the author gives the results of a scientific investigation, in order to ascertain how much of the energy of the current appears in the form of heat and of light energy in the ordinary incandescent lights. For these experiments he used an incandescent lamp of 110 volts, having resistance, when cold, of 300 ohms. The heat energy was measured by a thermopile, and the light energy by a prism-photometer. Several tables of results are given, showing that by far the major part of the electrical energy is converted into heat. With a current of .317 amp. the author finds 99.82 per cent. appearing as heat energy and only .74 per cent. as light, the latter gradually rising to 26.5 per cent. when the current had increased to .718 amp.; the lamp was then giving about 32 cp. Under the normal conditions of the 16-cp lamp, the author found about 85 per cent. as heat and 15 per cent. as light, with a current intensity of .621 amp.—*Zeit. f. Beleucht.*, July 13, 20.

New System of Incandescent Arc Lighting.—An article giving a table of tests of a new type of arc lamp and a description of the method stated to have been elaborated by Blondel, of arranging and treating the carbons. The carbons are constructed in several zones or layers, and the mineral admixtures, which are fusible salts chosen for their luminous capacity, are incorporated in considerable proportions with the carbon in the inner zones. The outer zone is formed of pure carbon, and it is stated that it protects the carbons against lateral combustion and also gives them the necessary conductivity. The arrangement of the electrodes is such that a very highly mineralized carbon is placed below another less mineralized, thus producing the result that the arc between the two is constantly situated below, and in the axis of a disk of refractory material. The latter disk serves as reflector and also to prevent the arc from climbing up on the upper electrode. The table shows that a lamp

of 3.3 amp. gives 1.5 times more light than a 10-amp. lamp of the old style and 6.5 times more than a 3.3-amp. old-style lamp.—*Rev. gen. des Sciences,* July 30.

REFERENCE.

Electric Light Plant for Dutch Torpedo Boats.—A short article, illustrated by drawings. The plant is designed to give 65 amp. at 80 volts when running at 500 r.p.m.—*Eng'ing,* July 31.

POWER.

Electrical Hoisting Plant for Coal Mine.—GUARINI.—An illustrated article, describing a plant recently installed at a German colliery. The hoisting engine has a daily capacity of 2,700 tons, with one platform, and 3,200 tons with two platforms. It is driven by two 1,400-max.-hp motors, one on each side of the driving pulley. Direct current at 500 volts is used in connection with a buffer storage battery. By the gradual switching in of the storage battery and alteration of the exciting current of the motor magnets, various speeds can be attained without undue energy losses. The starting gear consists of two perfectly separated starting resistances. The arrangement is described in detail.—*Western Elec.,* August 8.

REFERENCES.

Electric Harbor Cranes.—ROTHMUELLER.—A long, well-illustrated article, giving a description of various electric harbor cranes. The details of construction of the different types are given.—*Zeitsch. Oest. Ing. und Arch. Ver.,* July 17.

Electric Motors in Iron Works.—An illustrated article containing a description of the equipment of a plant for the manufacture of structural and ornamental steel and iron. The tools, cranes and lifting appliances in the works are driven by electric motors.—*Eng. Record,* August 1.

TRACTION.

Lowestoft Corporation Electric Tramways.—An article describing a traction line recently opened in England. The line is an overhead trolley installation, the main line being divided by the harbor, crossed by a swing bridge, situated almost exactly in the center of the town. The work calling for special note in connection with this system is the surmounting of the difficulties caused by this swing bridge. A shallow section of rail has been used, fixed to the ironwork of the bridge and electrically bonded to it. The maintenance of the circuit is secured in the following manner: Six light steel standards are mounted upon the bridge and carry an aluminum conductor of T section, which is further supported by stay wires. With this form of construction no undue strain is put on the bridge. A device is employed on the overhead line at either end of the bridge to connect the trolley wire with the mains when the bridge is closed. The overhead line on the bridge and the approaches are fed by a separate underground cable, connected through a switch placed on the bridge and operating with the movement of the bridge. When the bridge is tilted before swinging, current is completely cut off on this section and vice versa. The rail circuit is maintained under the harbor by means of a cable. The cables are drawn into a steel pipe, fitted internally with a wooden partition of star section, each cable laying in its own compartment, thus giving every facility for withdrawal and renewal. The cables are connected to a switch and testing board on either side of the harbor. The capacity of the whole installation is 1,575 kw, or about 1,900 kw on emergency load. The generating sets are so arranged that any one of them can be used for lighting or traction. High-speed engines, directly coupled to compound-wound generators are employed, the series winding of which is cut out if they are used for lighting. There are two 550-kw, one 250-kw, one 150-kw and one 75-kw generator. There is also a set of balancers and boosters of 18-kw capacity, and a set of 40 kw. The latter can be used for traction in case of emergency, as between the two balancers, on the same shaft, is a compound-wound, 80-kw motor-generator, which can be connected to the overhead line. A description of the permanent way and rolling stock is also given.—Lond. *Elec.,* July 24.

REFERENCES.

Interurban Electric Road for Hauling Coal.—An article describing the Denver & Northwestern Interurban road.—The road connects some coal mines 15 miles from Denver with the city. Special electric motor dump cars are used. The gauge is 3 ft. 6 in. The dump cars have four hoppers and can dump all of the load on either side and are all equipped with air brakes. The company also operates a passenger service.—*St. R'y Jour.,* Aug. 1.

Sleeping Cars on Electric Lines.—An editorial in which it is claimed that there is a field for sleeping cars, which is not now furnished by the steam railway companies. This is particularly the case between cities 150 to 200 miles apart. The sleeping car service of the steam railroads between such towns is usually inadequate because the distance is covered too rapidly and because the sleeping car and train schedules are made up for the convenience of through travelers, and not for local traffic of this kind.—*St. R'y Jour.,* August 1.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Automatic High-Tension Switches.—VOGELSANG.—An illustrated article containing a description of the author's constructions of high-tension circuit-breakers for alternating currents. He does not use alternating current in combination with series transformers, as is customary in American types, but a small maximum high-pressure relay operated with alternating current, and closing a local circuit of a continuous current from the exciter, and this operates the mechanism. He considers that this arrangement has the advantage of avoiding the heating of the relatively large coils which are constantly in the circuit in the other construction; it also constitutes a simplification of the mechanism in the case of polyphase circuit-breakers, in so far as only one magnet is necessary in place of two. The apparatus is so constructed that in connection with a time relay the contact is closed when a certain maximum current has been reached and is opened again, when the current should fall again to the normal before the time relay has acted. For a reverse-current relay the employment of series transformers is necessary, but as they only have to act on the relay, which is of very small size, they do not have to be large. When a time relay is used, the closing of the contact of the maximum or reverse-current relay actuates first the time relay, which then closes a second contact of a local direct-current circuit after a few seconds, which opens the switch.—*Elek. Zeit.,* July 30.

Mexican Water Power Electric Plant.—An illustrated description of a water power plant with electric distributing system at San Simonito, near the City of Mexico. A working head of about 700 ft. on the water wheels is obtained, with a normal output of about 1,200 hp. The generating machinery consists of three units of 300 kw each. Each unit consists of a 66-in., single-nozzle Pelton wheel, running at 360 r.p.m., coupled to the shaft of a three-phase, 6,600-volt and 60-cycle generator. The governing of the water wheel is accomplished by an electric relay governor, operating a deflecting hood over the nozzle. The guaranteed minimum efficiency of the alternators on non-inductive load, 100 per cent. power factor, is 92 per cent. at full load, 89 per cent. at half load and 82 per cent. at quarter load. There are two exciter units, each consisting of a 30-in. Pelton wheel at 850 r.p.m., direct-connected to a 20-kw dynamo of 60 volts. There are three 250-kw transformers, oil-insulated and water-cooled, which raise the potential to 25,000 volts for transmission. The sub-station equipment comprises transformers in units of 150 kw, which lower the potential to 2,200 volts and convert the three-phase into two-phase current for distribution.—*Eng'ing News,* August 13.

WIRES, WIRING AND CONDUITS.

New Cable Conduits.—A note on a new method of making conduits. They are formed by arranging long tubular cores in the excavations, which cores are covered on the outside with a thin layer of graphite and paraffine. They are then surrounded by cement, and after the latter has set, steam or hot water is introduced into the hollow cores, with the result that the easily-fusible layer melts and the cores can then be taken out. The fatty mass remaining on the inside of the tubes thus formed facilitates the drawing in of the cables.—*Elek. Zeit.,* July 23.

ELECTRO-PHYSICS AND MAGNETISM.

Induction Coils Operated with Alternating Currents.—WIEN.—An article describing a method employed by Prof. Wien to get the necessary high potentials at the secondary of an induction coil. He had an alternating-current machine constructed for 1,200 alterna-

tions (600 cycles) per second. The machine has 36 poles and runs at 2,200 r.p.m. The current was led directly into the primary of a large induction coil and a strong stream of sparks was immediately obtained between the terminals of a spark-gap 38 cm apart. He thus demonstrated that the potentials which are obtained by the use of interrupters can also be gotten in the manner described and thinks that a method is thus made available for an exact measurement of these high potentials.—*Phys. Zeit.*, August 1.

REFERENCES.

The Utilization of the Electric Waves.—Turpain.—A paper to be read as an introduction to the discussion of the subject of the utilization of electric waves, before the Physical Section of the French Association for the Advancement of Science, at the coming meeting. The author outlines the present state of our knowledge on the subject for telegraphic, meteorological, mechanical and lighting applications. —*L'Eclairage Elec.*, July 25.

Magnetic Observatories of the United States.—Bauer and Fleming. —An illustrated article, dealing mainly with the construction and the equipment of the Cheltenham Magnetic Observatory, at Cheltenham, Md. The construction and insulation of the walls of the observatory are described in detail.—*Scien. Am. Supp.*, August 8.

Electro-Chemistry and Batteries.

Active and Inactive Condition of two Identical Carbon Electrodes in Molten Electrolytes.—Harden.—The author made the observation that two carbon rods dipped into molten calcium chloride showed a difference of potential against each other, though they were not in connection before with any other source of current. It was thought that this might be due to thermo-electric currents as a result of the difference of the electrodes used; but the magnitude of the difference of potential observed was against this explanation. A carbon rod was carefully treated to free it from all impurities and then cut in two parts and both ends subjected to the highest white heat by means of a blast lamp. The millivoltmeter which was connected with the rods showed only 5.5 milivolts, when the two hot ends were in contact. They were then dipped into melting calcium chloride. As soon as the salt began to melt, the galvanometer showed a deflection, one time towards the right, and again towards the left. This movement took place every time when fresh electrodes were used, also when the bath was molten when they were introduced. After a short time, however, a steady activity of one electrode appeared, the deflection being steadily towards one side. The difference of potential increased with increasing temperature, going down again after this temperature had been overstepped. This point was with chloride of calcium at about 650° C., and the difference of potential amounted to 0.15 volts. This phenomenon was also observed with calcium nitrate, but to a smaller degree. The elevation of the melting temperature of the salt was also not the determinative factor, for if the electrolyte was molten chloride of lead, a difference of potential of 0.35 volts was observed, though the temperature was only 360° C. The distribution of the temperature seems to play an important rôle, for the amount of the difference of potential varied considerably if the crucible was heated only at one side, but the singular fact was ascertained that the activity was greatest at that electrode which had the lowest temperature. If one or the other electrode was heated alternately, the direction of the current was often reversed, but not always.—*Phys. Zeit.*, July 15.

Electrical Equipment of Carbide Works.—Perkins.—An illustrated description of the electrical equipment of the carbide works at Flums, Switzerland. The generating station has a capacity of 2,400 hp and is located 1.8 km from the works. Three large turbines of the horizontal type are each directly coupled to an 800-hp revolving-field, 5,000-volt, alternator of the three-phase type. Their dimensions and connections are such that they may be also used as single-phase machines supplying a current at the same potential. The power transmission line consists of six copper conductors insulated by porcelain and mounted on iron "tops" or caps upon wooden poles. The furnace room contains eighteen carbide furnaces, and the material is placed in them by an electric elevator. The transformer house contains three 850-kw, single-phase, oil-cooled transformers, with a ratio of 5,000 to 65 volts. The primary windings of the transformers are arranged with triangular connection with the high-tension conductors, the greatest fall of potential being 2 per cent. and the efficiency is 98 per cent. The secondary conductors are arranged for single-phase current from the transformers, the copper conductors having a cross-section of 4,800 sq. mm. and a total weight of 4.5 tons for each group of six furnaces. The current employed in each furnace is from 2,200 to 2,500 amp. The carbon electrodes are regulated by hand with chain gearing. The production of the carbide requires from two and a half to three hours, and it remains from 1 to 1½ hours in the furnace for cooling off. The eighteen furnaces are in continuous operation, and are arranged in groups of six or four, twelve being usually in operation at the same time. The weight of carbon electrodes required per ton of carbide produced are said to be about 30 kgms.—*Electrochemist and Metallurgist*, July.

Electrode Voltage.—Johnson.—An article on the electrode voltage or electrode potential and on the practical importance of measuring this quantity. A certain e.m.f. is in general necessary to pass as appreciable current through an electrochemical system. For electrolytic conduction Ohm's law states that amperes multiplied by ohms equal the difference between the impressed voltage and the critical voltage at which an appreciable current begins to flow. He compares this with the action of a safety valve which will not act before the critical pressure is reached. The critical voltage or decomposition voltage may be considered as the sum of the anode voltage and the cathode voltage. Each electrode voltage is determined separately by measuring the e.m.f. between the electrode and an artificial "standard electrode." Measurements of each electrode voltage separately are, for instance, used in practice to determine which of the two plates of a storage battery is exhausted first. When the total decomposition voltage is zero, the anode voltage is equal and opposite to the cathode voltage; this is, for instance, the case in copper refining. It is different in nickel refining, because the energy evolved in the solution of nickel from the nickel alloys in the cast nickel anode is not equal to the energy required to deposit nickel hydride on the cathode. The cathode voltage can easily be charged by adding a depolarizer to the catholyte. The article is illustrated by numerous diagrams.—*Electrochem. Ind.*, July.

The Present Position of the Theory of Electrolysis.—Whetham. —A paper read before the recent meeting of the Faraday Society, England. After a theoretical discussion of the dissociation theory, the author sums up his inquiry by saying that the phenomena of electrolysis and the osmotic properties of electrolytes clearly indicate that the conduction of a current through an aqueous solution consists in the convection of charged ions through the liquid, the ions being dissociated from each other while they are electrolytically alive. In a fused salt, however, it is possible that conduction may be due to a mere possibility of interchange between the electrified parts of the molecules, without any permanent and definite dissociation. Some process in the nature of Grotthus's chain may, in this case, secure the migratory freedom necessary for electrolytic conduction.—Lond. *Elec. Eng.*, July 9; abstracted in *Electrochem. Ind.*, August.

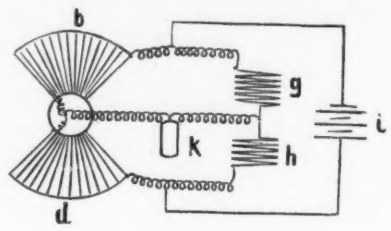
Units, Measurements and Instruments.

Accuracy of Standard Resistances.—Jaeger.—A summary of the results obtained at the Reichsanstalt in the work on standard resistances of mercury and manganine respectively. The opinion of Siemens, that the mercury standard could always be reproduced with accuracy, has been verified to an extent hardly expected by him, since the error does not exceed one or two parts in 100,000. The Reichsanstalt guarantees an accuracy of 1 in 10,000 in the resistances examined by it. It possesses five mercury standards made between 1890 and 1897. The mean value of the three new tubes differs from the mean of the two older tubes by only four parts in a million, the greatest departure of a single tube from the mean value being 2 in 100,000. As regards their reproduction, the main difficulty lies in the weighing of the mercury, which must adhere to the glass to within a fraction of a light wave. But the manganine resistances offer a convenient link between the mercury standards and the public. Within a period of 10 years a variation of the standard manganine resistances cannot be established with any certainty, although the electrical measurements can be carried out to within one part in a million. They do not vary by more than four parts in 100,000 in any case.—*Sitsungs. der Akad. Wiss.*, Berlin, May 7; abstracted in Lond. *Elec.*, July 24.

Electrical Revolution Counters.—An illustrated description of two

instruments for measuring the speed of rotating machines and for transmitting the indications to any desired distant place. The apparatus consists of a small magneto generator, which is connected with a voltmeter by means of thin wires. For a number of revolutions above 600 the generator is directly coupled with the shaft, the velocity of which is to be measured. For speeds below 600 gearing has to be employed. For machines which are reversible the instrument is so constructed that its zero point is in the middle, so that the direction of the revolution of the machine can be seen from the direction of the movement of the needle. This instrument can be used in any position and is completely enclosed to protect the commutator from dirt. Another apparatus consists of a small magneto alternating-current dynamo and an alternating-current voltmeter. It has the advantage of not requiring a commutator. The measuring instrument of this apparatus can only be used in vertical position.—*Der Electro-Techniker,* July 15.

Electric Transmission of Compass Readings.—A short illustrated description of the Siemens and Halske system for indicating compass positions at various places about a ship. The method depends upon bolometer action, the primary compass dial having a triangular piece cut out of it, above which is arranged an incandescent lamp. The transferring mechanism is indicated in the adjoining figure.



COMPASS INDICATOR.

Four quadrants of a circle, two of which, *b* and *d*, are shown, are arranged of wire grating and their center is directly under the center of the primary compass dial. Each two opposite quadrants constitute two branches of a Wheatstone bridge, the other branches of which are formed by manganine resistances *g* and *h*; *i* is the battery and *k* a coil of wire wound around a drum. If, now, the compass dial is so turned that *b* is exposed to the radiation from the incandescent lamp, then the resistance of *b* is increased and a current flows through the bridge and the coil *k*. The latter, wound on a drum and movably supported in a strong, nearly homogeneous, field between electromagnets, takes a position at right angles to the lines of force. The drum, therefore, exactly corresponds to the movements of the compass dial. The compass is said to have great stability, for the indications of the drum are independent of changes in the intensity of the heat radiations and the changes of intensity of the main current in the Wheatstone bridge, if only the same current travels through both connections.—*Elek. Rundschau,* July 1.

Influence of the Shape of the Current Curve on Induction Meters.—STERN.—A study of the influence of the shape of the alternating-current curve on the indications of induction meters, built according to the Ferraris principle. Such influence, if it existed, might cause errors in the readings if meters, which had been adjusted for a certain shape of curves, should be used on circuits with a different curve. Moreover, meters might indicate differently on account of the change of curve brought about by changes in the load during the day and night. Experiments were conducted with Ferraris meters of different construction, built by various makers in Germany. The curves obtained thereby are reproduced and analyzed. From the table of constants the author draws the conclusion that the induction meters manufactured in Germany indicate with sufficient accuracy even with great differences in the shape of the curve. The author then deduces a formula to separate the whole number of watts into watts of first, third, fifth, etc., frequency, and gives curves to show the percentage errors of the meters as a function of the present of the higher periodic watts. The errors are about of the same numerical order as the percentage of watts of higher frequency. As these are rarely more than 3 per cent. of the watts of higher periodicity, this number signifies at the same time the practical limit of error of induction meters, as far as the shape of the curve is concerned. The error is always such that the meter has the smallest constant with a pure sine wave: i. e., it then runs fastest; the more impure the wave, the slower the meter runs. The author thinks that the experiments show that none of the higher amplitudes are essentially different as far as bad influence on the meter is concerned. The third amplitude is usually regarded as especially harmful, but this is the case only when it appears stronger than usual; if the percentage of the fifth amplitude is as high as that of the third, it is just as harmful.—*Elek. Zeit.,* July 23.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—A note announcing the consolidation of the Braun-Siemens and the Slaby-Arco systems of wireless telegraphy in Germany. It is stated that it is proposed to evolve a new system combining the advantages of these two, which is to be called the German Spark Telegraphy System.—*Elek. Anz.,* July 23.

Telegraphophone.—An illustrated description of improved commercial forms of Poulsen's telegraphophone. Current from the secondary of an ordinary microphone and induction coil system passes through a coil surrounding a small magnet. A continuous steel surface is drawn past the latter, and the steel surface (wire, disk or ribbon, as the case may be) is magnetized in a manner corresponding with the variations of current produced by the voice. When the coil is connected to an ordinary telephone receiver and the magnetized steel surface again drawn under the magnet at the same speed, the words spoken into the microphone are reproduced. The chief novelties are as follows: In the smaller patterns of the instrument a steel disk is used, which is rotated by clockwork, while in the larger pattern steel wire is employed, which is wound off from one wheel to another by an electric motor contained in the base of the instrument. Sufficient wire is on the instrument to give a record ¾ hour long. Provision is made for erasing an old record before a new one is put on. The application of the principle of the instrument to the evolution of a telephonic relay is expected.—Lond. *Elec.,* July 31.

REFERENCES.

Telephone Progress and Prospects in England.—HANMER QUAIL.—An article discussing the tendencies of telephone service, especially the movement for a cheapened and improved telephone service.—*Telephone Mag.,* July.

Eastern Telephone Development.—DEMAREST.—A popular article, giving a historical review of the beginning and development of the independent telephone movements in the East.—*Tel. Mag.,* July.

Fessenden System of Wireless Telegraphy.—LINDOW.—A long, illustrated article, giving a description of the system, based upon the patent specifications.—*Elek. Zeit.,* July 23.

MISCELLANEOUS.

The Future of the Steam Engine.—A long editorial, dealing with the future of the steam engine, now that the original Parsons turbine patent has expired. The opinion is expressed that engine builders will have to enter this field, unless they content themselves with building the smaller class of prime-movers for which the turbine seems to be less adapted than for larger units. The makers of large reciprocating engines will have another course open to them, by building internal combustion engines, which promise to be the principal competitor of the steam turbine in the economical production of power on a large scale. It is stated that Brown, Boveri & Co., in the case of a 10,000-hp turbine, have guaranteed a steam consumption of 15.4 pounds per kw-hour, which is claimed to be equivalent to 8.8 pounds per indicated hp-hour. Comparison is made between the Parsons type and the Curtis type, as built by the General Electric Company of America. It is stated that the efficiency of the latter is not yet as high as that of the former, but that it is yet in its infancy, and there is no reason why with more experience better results should not be obtained. Even as matters stand the steam consumption of the Curtis turbine closely approaches the best figures given by engines of the ordinary type, being equivalent to a little over 11 pounds per indicated hp-hour. Attention is drawn, however, to the Potter system, comprising the use of steam at 300 pounds pressure, superheated by 200° F. or more, with a speed of 600 r.p.m. for a piston speed of 2,000 ft. per minute. It is stated that a steam consumption of under 9 pounds per indicated hp-hour is guaranteed by this system.—*Eng'ing,* July 31.

New Books.

ELECTRICAL ENGINEERING. An Elementary Text-Book. By E. Rosenberg. New York: John Wiley & Sons. 8vo. 267 pages, 263 illustrations. Price, $1.50.

The aim of this work is to meet the requirements of beginners, i. e., not the common reader desirous of getting a little "popular" literature on the subject, but the student or machinist who wishes to get sound fundamental ideas, so that the practical basis thus laid may be employed as a solid foundation for later superstructures. Mr. Rosenberg has been and still is chief electrical engineer at some of the leading works in Europe, and the translation from German into English has been done by Mr. Carl Kinzbrunner, one of his former associates, and by Prof. W. W. Haldane, both of whom are on the staff of the Municipal School of Technology, Manchester. Hence, one need hardly be surprised to find a distinct Teutonic and British flavor to the whole book, but this is due rather to the use of European apparatus than to anything else. Many of the appliances illustrated look odd or unfamiliar to American eyes, but they serve all the same to exemplify a principle or a method, and that is the main thing.

Basing his development of the subject upon lectures delivered before factory hands and other employees, Mr. Rosenberg has proceeded as usual from simple and elemental principles in electricity and magnetism, and while he covers a good deal of ground before he finally gets through his task, at no point does he outrun the ability of comprehension of any person of ordinary intelligence and education. The lectures are, as already intimated, not "popular" in the sense of those of Forbes or Fleming, as examples, but the goal in every case seems to be to work the idea out toward a concrete piece of apparatus rather than toward a perfect expression or a complete formula. In other words, while giving a fair grasp of the underlying physical concepts, its trend is wholly engineering and not philosophical; and considering its purpose perhaps no better praise could be offered. Moreover, for well advanced engineers also, it is a pretty thorough treatise on current European practice, although of course no attempt has been made to include all the standard machines and appliances there on the market.

Aside from the "trade" cuts, some of which have seen better days, there is a profusion of excellent new diagrams, clearly and strongly drawn, and these will be much appreciated by any mechanic or student. The book is also well arranged, well indexed and admirably printed, not with elegance, but in such a manner as to make the most of the 267 pages. A good feature are a number of "examples" in smaller type, although this is not carried out on any set plan.

INDIA RUBBER AND GUTTA PERCHA. A Complete Practical Treatise on India Rubber and Gutta Percha in their Historical, Botanical, Arboricultural, Mechanical, Chemical and Electrical Aspects. By John Geddes McIntosh. New York: D. Van Nostrand Company. 396 pages, 86 illustrations. Price, $7.50 net.

This handsome volume is a translation from the French of Seeligmann, Torrilhon and Falconnet, and Prof. McIntosh was formerly lecturer on the chemical technology of gums, resins, etc., at the Polytechnic, in London. It is divided into two parts, the first dealing with rubber and the second with gutta percha, and the method of treatment is the same in each case, beginning with the history, location, climatology, etc., and advancing through the methods of collecting the raw material to a consideration of its various properties. We then have the manufacturing treatment, the nature of the finished product and its many uses. A liberal amount of space is devoted to testing, with the inclusion of data on submarine cables under various aspects. Not the least valuable part of the book are the chapters given up to an enumeration and discussion of "substitutes," from which one gets an interesting glimpse into the vast possibilities of the sophistication of both raw materials, although it is by no means to be inferred that these pages tell everything in that direction. With the increasing use of the two gums, it is indeed inevitable that science and industry should seek to supplement the supply, just as wood pulp does that of rag. The electrical arts certainly owe much to these substances, even in their poorest grades; and it is not to be wondered at that Mr. Edison has said he would rather have discovered a perfect insulation than have made any of his other inventions.

Our electrical readers interested in the subject will find useful data in the chapters on vulcanizing and on ebonite. The book is in fact full of data, although some of it might have had a little more of the digester. There is an excellent index, and a quite interesting bibliography. The cuts are numerous.

Picnic of a Drafting Staff.

The annual outing or picnic of the staffs of Western electrical manufacturing companies is an established institution and one that might well be copied in other localities. During the present season one of the most successful of these enjoyable occasions was

A DRAFTING STAFF PICNIC.

the picnic given August 1 by the members of the Drafting Department of the Western Electric Company. Special cars conveyed the party to Cedar Lake, Indiana, where dinner was preceded by numerous athletic contests, including a 100-yard dash, with 45 entries; three-legged race, running long jump, swimming and diving competition, tug of war, boxing, etc.—the winner in the several contests receiving prizes in the form of a set of drawing instruments, slide rule, engineers' hand book, etc. The items of the mimeographed menu were disguised by electrical designations, with an occasional allusion to one of the diners.

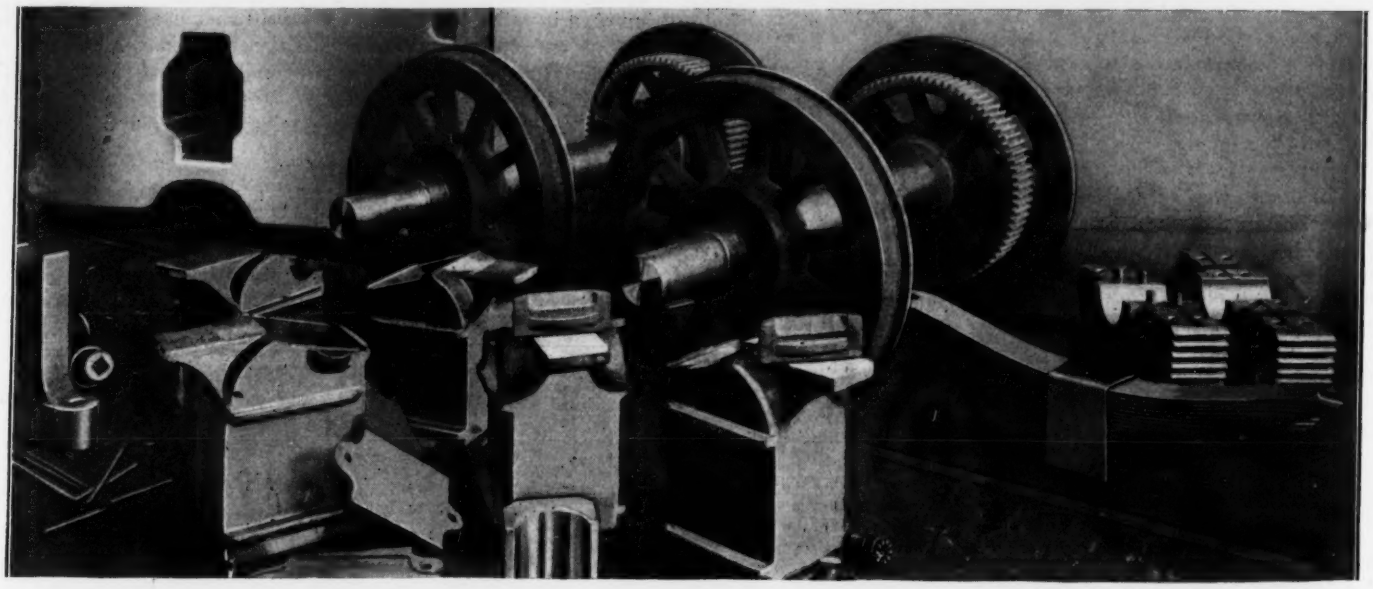
New B. & O. Locomotive.

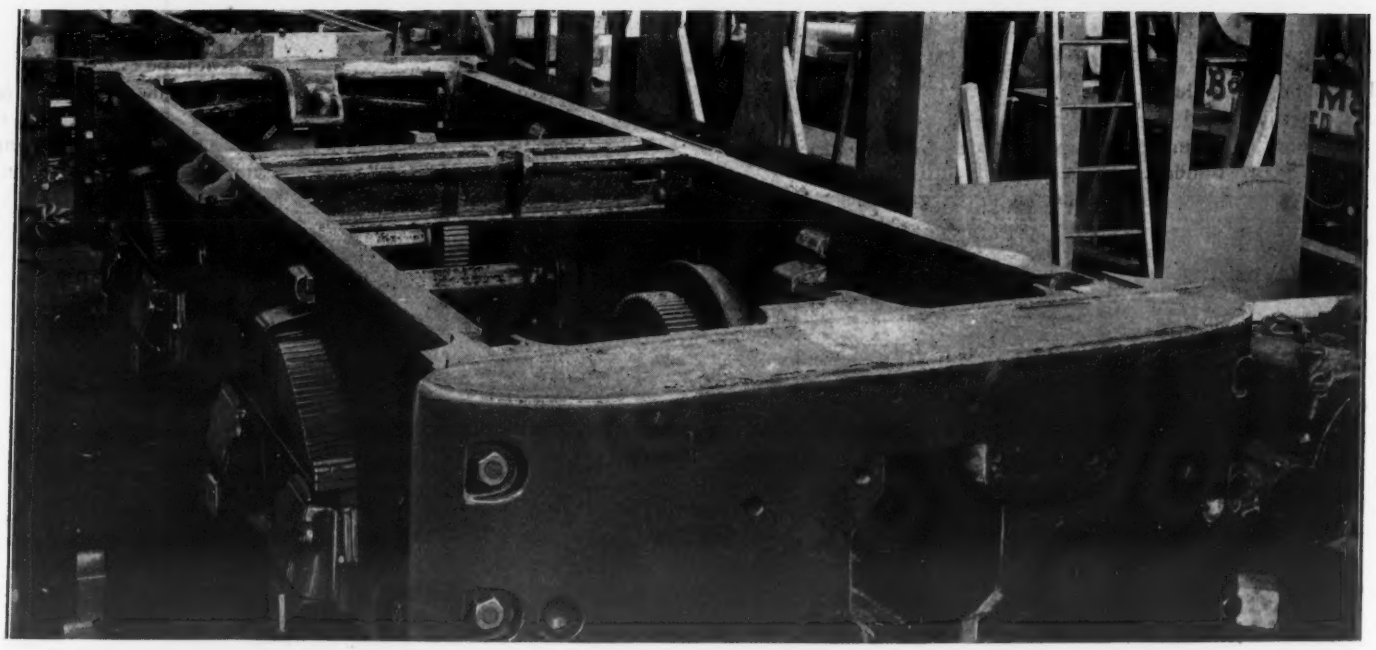
The most powerful locomotive in the world has just been built by the General Electric Company, at Schenectady, for the Baltimore & Ohio Railroad, for use in its tunnel underneath the city of Baltimore. This locomotive will handle all the freight traffic of the B. & O. which passes through Baltimore, and will operate over the same section as the present electrical locomotives built by the General Electric Company, and which have been in successful operation for the past eight years.

In designing this locomotive the specifications called for an electric locomotive capable of handling a 1,500-ton train including the steam locomotive, on a maximum grade of 1½ per cent. at ten miles per hour with corresponding higher speed on lighter grades. This required a locomotive weighing approximately 160 tons on the drivers for purposes of adhesion, and the engineers of the General Electric Company decided that the most practicable scheme was to build an articulated locomotive consisting of two complete 80-ton units operated together as one locomotive by means of the Sprague-General Electric multiple unit control.

The section of the road to be operated runs from Camden Street Station through the tunnel to the summit of the grade outside the tunnel, a distance of 3½ miles. Under practical operating conditions the motors have sufficient capacity to maintain this service hourly, running loaded up the grade and returning light.

On account of the simplicity and accessibility and minimum number of wearing parts, it is believed that the maintenance account of this locomotive will be very low. All wearing surfaces have been made large for the purpose of insuring long life. At the same time, special provision has been made for their easy replacement whenever





FIGS. 1, 2 AND 3.—NEW ELECTRIC LOCOMOTIVE FOR BALTIMORE & OHIO RAILROAD.

it becomes necessary. There is a large space under the cab floor in which a man can stand and inspect the motors or truck gear.

The whole locomotive consists of eight G. E. 65 motors, four on each half. These motors have each a capacity of 225 horse-power, making a total capacity of 1,800 horse-power. The main body of the truck frame consists of a rectangular framework of cast steel built up of four pieces, two side frames and two end frames, made strong and heavy. The parts are machined at the ends and securely fitted and bolted together, thus forming a very strong and rigid structure capable of withstanding the most severe shocks without injury. The end pieces form the buffer beams, and to these a suitable standard draft gear of approved design is attached. The side frames have machined jaws protected by wearing shoes between which the journal boxes slide.

The truck frames are supported at four points on equalizers. Each equalizer rests on a pair of half elliptic springs, the ends of which are supported on top of the journal boxes through suitable wearing plates. This construction forms a simple and effective arrangement of parts.

The journal boxes are made quite similar to standard car journal boxes, the parts, however, are made larger and stronger. The brasses can be easily removed, and by dropping down the wearing shoes it is possible to remove a journal box complete without removing the wheels and axles or other parts of the truck. In order that the locomotive may round curves easily, the axles are given considerable lateral movement in the journal boxes, it being practical to do this with this design of electric locomotive and thus reduce the effective rigid wheel base. Wheels, axles or motors can be easily removed from the trucks by dropping into a suitably constructed pit or by raising the truck frame.

Each section of the locomotive has eight steel-tired spoked wheels. The tires are 2⅞" thick with M. C. B. standard tread and flange and are securely held in place by approved fastenings. The axles are made of forged steel turned throughout, 6" x 12" in the truck journal bearings, 8" in the wheel fit and 7½" in the motor bearings.

The cab is large and roomy. The floor rests on the truck frame. The lining floor is made of 1¾" hard pipe tongued and grooved, the upper floor is of hard pine ⅞" thick, tongued and grooved and laid in the opposite direction from the lining floor. The sides and roof of the cab are made of sheet steel. On each side there is an entrance door, and at each end there is an additional door which permits of ready communication between sections when coupled together. Large windows afford a practically unobstructed view in all directions.

The controlling apparatus, consisting of master controller, engineer's valves, etc., is in duplicate, a complete set being located in diagonally opposite corners of each cab, so that the engineer, when it suits his convenience can stand in the front end of the locomotive when running in either direction.

Each section of the locomotive is equipped with one bell, one whistle, two locomotive headlights, approved air-brake mechanism, including two engineer's valves and air gauges, necessary brake cylinders, foundation brake, air reservoirs, couplers and draw heads; also Leach pneumatic track sanders. Each section of the locomotive is equipped with a multiple unit control so arranged as to be able to operate each section independently, or two or more sections coupled together.

Automobiles in England.

A cable from London of August 8 says: "After a long debate the bill regulating the use of motor cars on public roads was passed through the Committee of the Whole at 2.30 o'clock this morning. The House was keenly, even bitterly, divided on the subject, and the bill was considerably amended after it was received from the House of Lords, where it originated. As now amended, it provides for a maximum speed of 20 miles an hour on open roads and 10 miles in towns. Drivers must be licensed and cars must be registered. Fine and imprisonment are provided for driving to the public danger, and a fine is provided for not stopping in case of accident. Mr. Long, who had charge of the bill in the House of Commons, proposed to establish a test to determine the efficiency of drivers, leaving the decision to the House, which rejected the proposal. The bill will now have to be returned to the House of Lords for consideration of the amendments. A feature of the discussion was the impatient contempt on the part of those supporting the motorists toward what they regarded as the old-womanish conservatism of those insisting upon the protection of the non-motoring public. There was much heat on both sides, and the angry exaggerations of the disputants make amusing reading. Motorists liken the attitude of their opponents to that of the Chinese toward the first railway in China, which they bought up and destroyed because it terrified people. The other side, alluding to the selfishness of motorists, described them as "road hogs," driving infernal machines.

Magnetic Synchronous Clocks.

The usual systems of electric clock service are operated by currents produced either by primary or storage batteries. Among the disadvantages of these systems are the comparative unreliability of batteries and the wearing of the electric contacts, which render the service at times unreliable and always expensive, since their maintenance requires constant and skilled electrical supervision.

To obviate these objections is the purpose of a new system of clock service, known as the "Magneta," for which Hugo Reisinger, 11 Broadway, has acquired the American rights. In this system the master clock generates momentary currents which operate synchronously the system of secondary clock. The "Magneta" system, which is of Swiss origin, is rapidly gaining ground in Europe, where it has recently been adopted by the city of Cologne for a street clock service, and been installed in Palace of Justice, Hamburg, and in the railroad stations and offices at Frankfort, the service in the latter city also extending to many of the prominent buildings and to the new Palast Hotel.

Briefly, the master clock each minute causes a bobbin to make a rapid quarter revolution in the field of an electromagnet. The

MAGNETIC CLOCK.

current thus generated operates all of the secondary clocks connected, by actuating the armature of an electromagnet, which armature controls a clock escapement. The details have been very carefully worked out, provision being made in the master clock for the continuance of its synchronism, while the driving mechanism is being wound up. The driving is attached to the striking movement, which latter in turn actuates each minute the clock movement and, consequently, the magneto generator.

A very interesting and complete working exhibit of these clocks can be seen at 11 Broadway, New York, in the extensive offices occupied there by Mr. Reisinger, including various types of dial, etc., so as to illustrate fully the method of operation and the results.

Marconi System In Alaska.

Engineer Richard Pfund reports from Alaska that all of the Marconi stations in that region will be completed and in operation by the signal corps in the course of a few days. He also reports that the wire and cable lines were destroyed during the last winter, making communication impossible.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In referring to the depressed condition of the stock market last week, we expressed the opinion that while the blows given to the market were of a most punishing character, it was nevertheless true that August usually saw a rise in prices. It would now appear that this August is to prove no exception to the rule, for although the quotations remain far below what they were last year, there has been a very sharp and sustained rise all along the line. So far as can be judged, the semi panic which prevailed, and which caused the throwing overboard of good securities at great sacrifice, was restricted to Wall Street, giving an excellent opportunity to people with money all over the country to come in and pick up securities which yield an excellent return on the investment. The shake-up in the street has naturally caused a great deal of heart-searching and investigation, and newspapers and all kinds of authorities have been probing the situation to see whether anything is really and seriously the trouble after all. The net result of the investigation is most encouraging, for all the reports are of a hopeful tenor, and nothing has appeared to prove that trade is suffering from over-production or that commercial credits have been unduly strained. It is just as well that there should be conservatism and prudence, but so long as these qualities are exercised there is nothing in sight to prevent the country from pursuing the path of prosperity which it has now been treading for some years. In fact the financial troubles of the past week or two have witnessed such a wholesale reduction in prices of all shares that this period might well mark the beginning of "better times"; for one would have to go back almost to 1893 to find the parallel for such tremendous slumps as have marked some quotations. We are glad to note the renewed strength of electrical stocks, as indicated by many of the quotations given below for August 18th:

NEW YORK.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
American Tel. & Cable	77	77	General Electric	154	168
American Tel. & Tel.	129⅜	136	Hudson River Tel.	..	..
American Dist. Tel.	25	25	Metropolitan St. Ry.	111	116
Brooklyn Rapid Transit	41	47⅜	N. E. Elec. Veh. Trns.	5	6¼
Commercial Cable.	..	149	N. Y. & N. J. Tel.	..	..
Electric Boat	13	16	Marconi Tel.	1⅜	1⅝
Electric Boat pfd.	39	40	Western Union Tel.	81⅝	83¾
Electric Lead Reduction.	2	1¾	Westinghouse com.	..	170
Electric Vehicle.	7	8	Westinghouse pfd.	..	175
Electric Vehicle pfd.	10	11			

BOSTON.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
American Tel. & Tel	129⅜	136	Western Tel. & Tel. pfd.	83	83
Cumberland Telephone	..	..	Mexican Telephone	1⅛	..
Edison Elec. Illum.	235	238	New England Telephone	127	126½
General Electric	154	168	Mass. Elec. Ry.	..	23¼
Western Tel. & Tel.	13	13	Mass. Elec Ry. pfd.	..	80½

PHILADELPHIA.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
American Railways	43	45	Phila. Traction	94¼	95½
Elec. Storage Battery	..	..	Phila. Electric	5⅛	5¾
Elec. Storage Battery pfd.	60	57⅛	Phila. Rapid Trans.	..	13
Elec. Co. of America.	7⅞	8⅛			

CHICAGO.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
Central Union Tel.	..	..	National Carbon pfd.	92	91
Chicago Edison	..	..	Metropolitan Elev. com.	..	23
Chicago City Ry.	165	170	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	..	23½			

ELECTRICITY ON MANHATTAN ELEVATED.—The quarterly report of the Interborough Rapid Transit Company, embracing the figures for the operation of the Manhattan Elevated Railway lines since April 1, when the subway company took them over under lease, shows an increase in earnings and decreases in operating expenses as well as increase in the number of passengers carried. The gross earnings of the company, all from the operations of the elevated lines, were $3,271,787, an increase of $414,537 over the gross earnings of the corresponding period of 1902, under the old management. The expenses were $1,302,089, a decrease of $99,217. The three months' net earnings amounted to $1,969,698, an increase of $513,554. The item of "other income" is $90,187, a decrease of $21,100, the figures for the total income being $2,059,885, an increase of $492,454. Interest and taxes were $684,563, an increase of $28,714, making the three months' surplus $1,375,322, an increase of $463,740. The passengers carried numbered 66,105,436, against 57,699,248 in the corresponding period of 1902, an increase of 8,406,188. The report for the year, including the Manhattan and the Interborough figures, shows $12,208,337 gross receipts, an increase of $1,542,426 and 246,587,022 passengers carried, against 215,259,345 carried in the previous year, an increase of 31,327,677 passengers. The operating expenses were 44.73 per cent., against 51.74 per cent. the year before, a decrease of 7.01 per cent.

SUSQUEHANNA POWER.—The statement is made that the Susquehanna Power Company, which was recently incorporated for the purpose of harnessing the water power of the Susquehanna River and conveying it for use in Baltimore, has secured subscriptions to nearly $10,000,000 of its capital, and is about to sign a contract with the General Electric Company for electrical machinery involving, before the apparatus shall all have been installed, the expenditure of from $2,500,000 to $3,000,000. Mr. S. Davies Warfield, president of the Continental Trust Company, who is the only one in a position to make an authorized statement, when shown this dispatch, said: "There is no statement to be made public at this time regarding the Susquehanna project." It is known that the engineers and others identified with this project have been exceptionally busy for the past six months. A number of well-known electrical and hydraulic engineers have made exhaustive investigations of the project for leading Northern and New England capitalists. The enterprise is looked upon with great favor in those quarters, especially among interests which have had experience with similar projects. It will be a big thing for Baltimore, as it will supply an abundance of cheap power. Three developments of 50,000 hp each are planned, and every detail of the construction has been completed. The power company will furnish current to the United Railways and to the United Electric Light & Power Company, of Baltimore.

AN OPPORTUNITY IN GAS.—The following story is told by the *Wall Street Journal* as to the stock of the Consolidated Gas Company, which controls electric lighting in New York City: "A year ago a capitalist who owned 2,000 shares of Consolidated Gas, then selling at 223, sold at that figure, and has loaned the money which he received for the stock—namely, $446,000, at the generally high rates of interest which have since prevailed. In other words, he found that money could be used more profitably by loaning it out than by keeping it invested in this high-priced stock, which was then yielding him less than 3.65 per cent. a year. On Tuesday this same capitalist purchased 2,000 shares of Consolidated Gas at about 166, paying therefor $332,000. To-day he finds himself the possessor not only of the same stock which he owned a year ago and then sold, but also a profit of $114,000 in cash. The stock has not depreciated in value since then, so far as the payment of dividends is concerned, and now he holds it at a purchase price which makes the income per year a reasonable profit for the use of his money. The $114,000 profit which he has secured through the sale and then repurchase of the stock, is, in addition to the profit which he has made by the loaning of the $446,000 during the past year. He has by this operation increased both his capital and his yearly income."

BUYING GENERAL ELECTRIC.—An article on the recent active buying of stock in small lots says: "All of the transfer offices in the financial district have been rushed for weeks to make out certificates in the names of small investors. Although the stock market tape has shown recently an unusually large aggregate of odd-lot transactions, a large proportion of such buying is done in round lots by the brokers, the certificates being split up afterward. For example, a broker having ten odd-lot orders in the same stock for ten shares each would buy a 100-share lot and send it to the transfer office to be "split up." There are brokers who make a specialty of this old-lot business and among them they piece round lots out of odd lots. It saves work and besides better execution is possible on round lots. The buying of 2,000 shares of General Electric on Monday to be split up into small lots is an instance. The floor specialist in General Electric did that. Reports from Amsterdam, N. Y., say that the population within range of the company's plant has been loading up with odd lots of this stock."

QUEENS COUNTY (L. I.) TROLLEY.—One of the Wall Street news bureaus has printed the following: "We have excellent authority for the statement that the control of the Queens County traction companies has been bought by the Long Island Railroad Company, and that neither the Belmont nor Rockefeller interests had anything to do with the recent change of ownership of those companies, notwithstanding the many reports to the contrary. The same authority states that the Pennsylvania Railroad, which has acquired the Queens County companies through its ownership of the Long Island Railroad, has also secured a very large interest in the Brooklyn Rapid Transit Company. William C. Giles, of 41

Wall Street, is said to have been the active intermediary in the negotiation which was consummated by the purchase of the control of the Queens County companies, but he positively declines to confirm or deny the statement."

CAR WHEEL DEAL.—It is stated that a consolidation of eight of the car wheel manufacturing plants of the country is under way. Appraisals are being made. The plants to be consolidated have a daily output of about 2,700 wheels, consuming approximately 1,000 tons of iron and scrap. The new company will produce about one-fourth of the wheels produced in this country annually. The American Car and Foundry Company and the Griffin Car Wheel Company are the two largest producers, their plants having an output of about 1,000 wheels each. The following concerns have given options on their plants: Rochester Car Wheel Company, Rochester, N. Y.; Maher Car Wheel Company, Cleveland, Ohio; New York Car Wheel Works, Buffalo; Cayuga Wheel Company, Syrepa; Lobdell Car Wheel Company, Wilmington, Del.; Maryland Car Wheel Company, Baltimore; Ramapo Car Wheel Company, Ramapo, N. Y.; Keystone Car Wheel Company.

GOOD GENERAL ELECTRIC BUSINESS.—The recent decline in General Electric, according to Wall Street authorities, was accentuated by the forced selling by parties who received the stock in exchange for Stanley Electric Company stock. New business with the General Electric Company has received a passing check, as new promotions in the electric railway line have been halted by reason of the difficulty in floating new securities. The company has orders which will keep its plants in full operation into 1904, and, as a matter of fact, its May and June business was the largest in the company's history. It is stated that for the six months ended July 31 the business has increased 10 per cent. over the same months in 1902, and contracts in hand indicate a gross business this year of fully $40,000,000, an increase over last year of $4,000,000.

THE CUYAHOGA TELEPHONE COMPANY, of Cleveland, reports the following figures for its independent system for six months ended June 30, 1903, as compared with the previous 12 months:

	1903. 6 months.	1902. Year.
Gross	$201,566	$385,852
Expenses and taxes	104,968	229,710
Net	$96,598	$156,142
Interest	58,115	*155,600
Surplus	$38,483	$542

* Includes $40,858 for depreciation.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The $9,135,200 of assenting stock of the Westinghouse Electric & Manufacturing Company, to list which application has been made to the Stock Exchange, is stock that has been issued to stockholders in order to raise money for making extensions to plants to meet the growing business of the company and for working capital. A portion of this stock was issued in 1901, and the amount includes the $4,500,000 issued in May, which was taken by stockholders at $80 per $50 shares. This makes the amount of assenting stock outstanding $18,516,551, leaving nearly $2,500,000 of this stock still in the treasury.

ELECTRIC CANAL PROPULSION.—At Cincinnati on August 15, Receivers Schoepf and Richardson, of the Miami and Erie Canal Transportation Company reported to the Superior Court on the condition of the concern, which is equipping the canal for the electrical propulsion of boats. The total expenditures have been $1,285,549, while the assets are $118,722, principally in power houses, locomotives and building material. More than $125,000 has already been spent for equipment. It is estimated that it will require $217,200 to complete the line from Cincinnati to Dayton.

CHICAGO METROPOLITAN ELEVATED.—Directors of the Metropolitan Elevated road have voted to pass the semi-annual dividend on the preferred stock. This was due, according to the official statement, to the fact that the earnings for only four months were actually known to the directors, and the increased cost of operation, materials and supplies and the extraordinary settlements for damage and injury suits formerly pending.

BELL TELEPHONE.—By officials of the American Telephone & Telegraph Company it is stated that judging from subscriptions received to date practically all of the $21,943,200 new stock will be taken by stockholders.

DIVIDEND.—The directors of the American Railways Company have declared the regular quarterly dividend of 1½ per cent., payable September 15.

THE V. R. LANSINGH CO., of Chicago, has decreased its capital stock from $30,000 to $17,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The various reports from different parts of the country as to fall trade indicate that the general conditions are excellent, and that the excellent promise of the crops has stimulated the renewed hopefulness and activity. While it is naturally a dull season it would appear that preparations for fall trade are unusually large, and that even at this moment many manufacturers are working overtime. The railroads also are reporting congestion of traffic, particularly around Kansas City, in the coal regions of Pennsylvania, and in the lumber district of the Northwest, while out in the wheat fields it is reported that great quantities of grain are being dumped on the bare ground owing to sheer lack of storage capacity. The railroad earnings for August show an average gain of 7.7 per cent. over last year, and 16.3 per cent. over 1901. Bank exchanges for the week in New York, owing to the stock exchange depression, were 5.6 per cent. less than a year ago; but were 21.7 larger than in 1901. Other large cities, however, show a gain for the week of 7.2. With regard to the copper market, that also must be reported strong, as we ventured to think it would be, and prices have advanced from ¼c. to ⅜c. a pound, and active inquiry is reported for lake at 13½c. bid. Advices from London also report copper stronger there, and it is said that foreign consumers who have allowed their stock to run down are buying. It would appear that something of the kind must be the case, as the exports of copper lately have been quite below the average.

AKRON DYNAMO AND MOTOR ORDERS.—The Akron (Ohio) Electric Manufacturing Company reports the following recent orders: Green-Wheeler Shoe Company, Ft. Dodge, Iowa, one 15-kw generator; Goldsboro Lumber Company, Dover, N. C., one 30-kw belted generator; Trow Directory Publishing & Book-Binding Company, New York, one 100-kw generator, one 50-kw generator; Florence Iron Works, Florence, N. J., one 150-kw belted generator, four 20-hp motors; U. S. Pump & Supply Company, Toledo, Ohio, one 35-hp steel motor; F. R. Penn Tobacco Company, Reidsville, N. C., one 20-hp motor; Astoria Steel Company, Astoria, N. Y., one 7½-hp motor; S. B. Stine & Son, Osceola Mills, Pa., seven 20-hp motors; Salt Lake Hardware Company, Salt Lake City, Utah, one 30-kw engine type generator; Silver Lake Park Company, Silver Lake, Ohio, one 120-kw belted generator; W. S. Tyler Company, Cleveland, Ohio, one 25-hp steel motor; Troy Laundry Company, Cleveland, Ohio, one 60-kw engine type generator, one 1½-hp belted motor; Ward-Corby Company, Chicago, Ill., two 12-hp belted motors, one 15-hp direct-connected generator, one 50-hp direct-connected generator, one 75-kw direct-connected generator; Ward-Corby Company, Pittsburg, Pa., two 15-hp belted motors, one 15-hp direct-connected engine type generator, one 50-hp direct-connected engine type generator, one 75-kw direct-connected engine type generator; Conron Bros., New York City, one 100-kw engine type generator, one 75-kw engine type generator; Jefferson Ice Manufacturing Company, Janney, Pa., one 22½-kw generator, one 5-hp steel motor, one 10-hp Crane motor, one 2-hp steel motor; C. C. Heisen, 350 Dearborn Street, Chicago, Ill., one 200-kw generator; Iron City Engineering Company, Pittsburg, Pa., one 25-hp motor, one 50-kw engine type generator; Imperial Engine Company, Painted Post, N. Y., one 15-hp steel motor; H. Loeb, Caledonia, Pa., one 35-kw generator; Donovan Iron & Wire Works, Toledo, Ohio, one 90-hp motor, one 1½-hp steel motor and the same style as follows: two 3-hp, one 20-hp, three 7½-hp, one 10-hp, one 5-hp, one 2-hp; Deming Ice & Electric Company, Deming, Luna County, New Mexico, one 50-kw generator; W. H. Smith & Co., Indianapolis, Ind., one 20-kw generator; The Wehrle Company, Newark, Ohio, one 10-hp motor; Central Electric & Manufacturing Company, Youngstown, Ohio, one 35-kw engine type generator; Aurora, Elgin & Chicago Railroad Company, Batavia, N. Y., one 10-hp steel motor; Aultman Company, Canton, Ohio, one 7½-hp crane motor; Cream of Oats Company, Warren, Ohio, one 10-kw belted generator; Dravo, Doyle & Co., Pittsburg, Pa., one 10-hp steel motor; James Reely Repair & Supply Co., 229 West Street, New York City, one 30-hp steel motor, one 2-hp elevator motor; Murray Iron Works Company, Burlington, Iowa, one 10-hp, one 12-hp, one 6-hp crane motors; Murphy Varnish Company, Newark, N. J., one 1-hp, one 15-hp, one 3-hp motors; Warren Sheet Metal Company, Warren, Ohio, one 45-kw generator, two 15-hp motors; Allegheny Plate Glass Company, Hite, Pa., one 20-hp motor.

BALL ENGINE RECENT SALES.—The Ball Engine Company, Erie, Pa., report the following shipment of engines for electric service during July, all direct-connected, where not otherwise stated: Longmont Beet Sugar Company, Longmont, Colo., one 150-hp direct-connected engine; two 250-hp direct-connected engine. Lookout Mountain Iron Company, Battelle, Ala., one 125-hp engine; Hamilton Hotel, Louisville, Ky., one 100-hp; one 80-hp. Vermont Hospital for Insane, Waterbury, Vt., one 125-hp. Polyclinic Hospital, Philadel-

phia, Pa., two 80-hp. Tawas Sugar Company, East Tawas, Mich., one 50-hp; one 80-hp. Alvey & Ferguson Company, Louisville, Ky., one 150-hp. Owosso Sugar Company, Owosso, Mich., one 50-hp; one 80-hp. Imperial Tobacco Company, Rocky Mount, N. C., one 80-hp. Imperial Tobacco Company, Wilson, N. C., one 70-hp. Pittsburg Coal Company, Allison Mine, one 400-hp. Federal Chemical Company, Nashville, Tenn., one 40-hp. Washington Electric Light & Power Company, Washington, Pa., two 350-hp. Jefferson Coal Company, Piney Fork, Ohio., one 350-hp. California Fig Syrup Company, Louisville, Ky., two 50-hp. Cooper, Wells & Co., St. Joseph, Mo., one 150-hp. Manhattan Railway Company, New York City, two 150-hp. Menominee River Sugar Company, Menominee, Mich., one 60-hp; one 80-hp. Windsor Sugar Company, Windsor, Colo., one 60-hp; one 80-hp. Fort Collins Sugar Company, Ft. Collins, Colo., one 150-hp; two 250-hp. Stewart & Co., store, Baltimore, Md., one 200-hp vertical double direct-connected. First National Bank Building, Chicago, two 300-hp, vertical cross-compound, direct-connected.

IMPORTANT MEXICAN PROJECT.—Americans are primarily interested in another important Mexican electrical project which will embrace the supplying of the city of Guadalajara with light and power and the construction of an extensive system of electric railroads through the State of Jalisco, within a radius of some 100 miles of Guadalajara. Captain W. A. Rogers and Arturo Latour de Vasquez are the principal parties concerned. The syndicate, according to advices from Mexico, has acquired from Facundo Perez a concession to develop water power along the Santiago River, in the State of Jalisco for a distance of about 17 miles. This concession extends to the boundary of the grant that is held by the French company now generating current for Guadalajara. San Cristobal, a town about four miles from Guadalajara and two miles below which the concession of the new syndicate applies, will be made the principal power station. It is expected that within two years 60,000 hp will be at the disposal of the new concern. In about a year the first 10,000 hp will be available. In order to secure the fall necessary to generate the power, long ditches will have to be constructed through rock. The longest ditch will be about ten miles. The fall thus gained will be more than 500 meters.

PURCHASE BY GREGORY ELECTRIC COMPANY.—Mr. A. O. Kuehmsted, vice-president of the Gregory Electric Company, of Chicago, writes us as follows: "We have bought out the stock of dynamos, motors, electrical supplies and the repair department, together with the good will of this part of the business, of our leading competitors here in Chicago, Schureman & Hayden, and are going to continue that business at the old location. Our Mr. R. H. Watson will have charge of this warehouse. Our general offices will continue as heretofore at 54 to 62 South Clinton Street. This new place gives us now three warehouses here in Chicago, all of these well located and especially equipped for handling electrical machinery, warehouse No. 1 and the main offices being at 54 to 62 South Clinton Street; warehouse No. 2 on the Chicago, Burlington & Quincy Railroad tracks, at Sixteenth and Lincoln Streets, especially arranged for handling railway generators and large apparatus, and warehouse No. 3, the Schureman & Hayden stock and repair works, at 133 to 139 South Clinton Street."

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone & Telegraph for the month ended July 20 and since December compares as follows:

Month ended July 20:	1903.	1902.	Changes.
Gross output	69,194	59,935	Inc. 9,259
Returned	44,116	34,054	Inc. 10,062
Net output	25,078	25,881	Dec. 803
Since Dec. 20:			
Gross output	669,258	648,044	Inc. 21,214
Returned	279,257	260,321	Inc. 18,936
Net output	390,001	387,723	Inc. 2,278

During July the Chicago Telephone Company achieved a net gain of 1,485 telephones for city and country, bringing telephones in use up to 92,214; the increase over July, 1902, being 294. The company expects to reach the 100,000 mark about January 1st.

PUYALLUP POWER HOUSE.—The contract for building the great power house of the Puget Sound Power Company out on the Puyallup River has just been let to Rydstrom & Bihler, of Tacoma, Wash. The contract calls for the completion of the plant December 1 of this year. The contract includes the erection of the fifty-ton crane, which is required in the works for the movement of the huge parts of the machines to be installed. It is also provided that the contractors shall be prepared for the installation of the interior machinery before the completion of the building, as much of the machinery could not otherwise be got into the power house at all. Mr. Bihler is well known as having long been at the head of the engineering department of the Northern Pacific Railroad, besides which he has been in his time engaged in heavy contracting. Mr. Rydstrom is perhaps best known from his former position of commissioner of public works.

CURTIS TURBINE FOR NEW OMAHA LIGHTING PLANT.—The Thomson-Houston Electric Light Company, of Omaha, has let contracts through the United Electric Securities Company, of Boston, Mass., for considerable equipment, to be installed in its new plant. The General Electric Company has taken a contract for two Curtis turbines of 1,500-kw capacity each. The condenser will be built by the Wheeler Condenser & Engineering Company. The contract for the boilers calling for 2,000 hp in four units and for superheaters and chain grate stokers has gone to Thayer & Co. They will be Aultman & Taylor make. The stokers will be built by the same firm. The superheaters will be manufactured by the Power Specialty Company, New York.

ELECTRICAL MANGANESE PLANT.—Arrangements have been completed for the establishment of electrical manganese works at Shawinigan Falls by the Electrical Manganese Company, of which B. E. Kingman, of New York, is president. The company has secured twelve acres of land on the Great Northern Railway at Shawinigan and contracted with the Shawinigan Water & Power Company for the delivery of 5,000 hp. According to their contract, 1,200 hp is to be delivered the company for its manganese plant by August 15. It is the intention of the company to enter upon the manufacture of different kinds of steel, and it is on this account that such a large contract for horse-power was made.

EQUIPMENT FOR LITTLE ROCK PLANT.—The Little Rock (Ark.) Electric Light & Traction Company, controlled by Newman & Sons, of New Orleans, La., has just awarded contracts through Ford, Bacon & Davis, 24 Broad Street, New York, for various equipment to be installed in its new plant. The General Electric Company has taken the contract for the generators—two of 1,500-kw capacity each, direct-connected to cross-compound condensing engines of 2,000-hp capacity each. The engines will be Allis-Chalmers. The boiler contract for 2,000 hp in four units was allotted to Thayer & Co., Incorporated, for the Aultman & Taylor Machinery Company, Mansfield, Ohio.

IMPORTANT SOUTH AMERICAN TRACTION PROJECT.—An extensive trolley system is to be constructed in the City of Rosario by the Anglo-Argentine Company, an English syndicate represented by William Gay. Several horse lines will be electrically converted. The scheme, according to South American advices, is a very comprehensive one, involving every quarter of the city. Agar, Cross & Company, a well-known South American commission house which represents the Westinghouse interests in the Argentine Republic and Uruguay, and whose New York offices are in the Bowling Green Building, are after the contract for the power house equipment, etc.

STEAM RAILROAD CONTRACT.—The Buffalo, Rochester & Pittsburg Railroad has just let contracts for the complete electric equipment of their present shops and roundhouse at Buffalo Creek and the proposed shops and roundhouse at the junction of the Buffalo & Rochester divisions near Salamanca. Both plants will be operated by electric power and lighting, which means the expenditure of many thousands of dollars in the original equipment. The contracts have been awarded to the General Electric Company through the efforts of A. C. Smith, one of the General Electric Company's representatives in Buffalo. Work will be soon started.

SIGNALPHONE CONTRACT.—The Signalphone Company, of Milwaukee, is completing the contract for equipping the grounds of the Louisiana Purchase Exposition at St. Louis with a police telephone system. The company has already shipped $7,000 worth of equipment to the grounds and the work of installing the system will be commenced shortly. The system will be complete and telephones will be placed so as to be easily accessible from any part of the grounds. It is expected that the system will afford the St. Louis fair more ample police protection than given any of the large expositions during the past few years.

EQUIPMENT FOR FALL RIVER LIGHTING PLANT.—The Fall River (Mass.) Electric Light Company is at present awarding contracts through French & Hubbard, of Boston, Mass., for equipment for its new power station. Thayer & Co., Incorporated, Boston office, has secured the boiler contract. There will be four units, making in all 3,000 hp.

BULLOCK ORDERS.—The Bullock Electric Company has secured a contract amounting to $50,000 from the Chicago Elevated roads for electric equipments. The company's business for July was the largest in its history.

MEXICAN LIGHTING PROJECT.—An electric light plant is to be built in the town of Tamazula de Gordiana, State of Jalisco, Mexico. Steam power will be used. Vincente Viera is interested in the undertaking.

General News.

THE TELEPHONE.

SANTA ANA, CAL.—The Home Telephone Company has let a contract for a $13,000 pressed brick building here.

DELTA, CAL.—The contract for building a telephone line from Delta, on the railroad to Shasta County, by way of Trinity Center to Carryville, Trinity County, has been awarded. The line will follow the Northern Trinity toll road, and will be 30 miles in length. Later the mine owners of the Coffee Creek district will extend the line to their properties.

DENVER, COL.—Orders have been issued by E. B. Field, of the Colorado Telephone Company, for the extension of the company's lines into Grand Lake, Hot Sulphur Springs and Kremmling. It is expected that the lines to these points will be in operation within the next ninety days.

NEW BRITAIN, CONN.—The capital stock of the Farmington Valley Telephone Company, of New Britain, has been increased from $10,500 to $27,000.

CHICAGO, ILL.—The Farmers' Telephone Company, of Lee County, has been formed to operate a telephone system. Capital, $2,500. Incorporators: Albert N. Crawford, Henry W. Hillison, Christian Gross.

BRYANT, IND.—The Bryant Telephone Company has been formed with $10,000 capital.

INDIANAPOLIS, IND.—The State Board has fixed the assessment on telephone property in the state at $6,819,552, as against an assessment last year of $5,043,579, an increase during the year of $1,765,973.

BURLINGTON, IA.—The Modern Telephone Company, of Burlington, has been incorporated; capital $300,000.

DES MOINES, IA.—The Summit Rural Telephone Company has been formed in O'Brien County. Capital $1,000.

WATERLOO, IA.—The city council has granted the right to the Iowa Telephone Company to place their wires underground. The company will expend $100,000 in this city, part of it being in a fine new building with offices and general supply quarters.

SUMNER, IA.—A majority of the stock of the Sumner Telephone Company, capital $30,000, and owning about 150 miles of line and large exchanges at New Hampton and West Union, Iowa, has passed in the hands of Victor Stevenson, who controls the Standard and Interstate lines.

DES MOINES, IA.—The Mutual Telephone Company has decided to buy a Stromberg & Carlson multiple switchboard and connections. This board has a capacity of 12,500 and will be fitted up for 3,600 telephones. It will cost $95,000. This does not include the conduits to carry the wires underground into the exchange building.

LANACONING, MD.—The Western Maryland Telephone Company contemplates putting in a line from Eckhart to Clarysville.

ONAWAY, MICH.—The Onaway Telephone Company gives service to Onaway and Rogers City from two switchboards of 135 and 100 drops respectively. It has 160 and 100 subscribers, 130 miles of toll line, with 50 more projected and 70 waiting subscribers.

DETROIT, MICH.—The Co-operative Telephone Company has issued a list of "Independent" exchanges with which it connects throughout Michigan, containing the names of 575 places not on other companies lists. The Co-operative is putting stations in a number of down-town places.

DETROIT, MICH.—The Michelson & Hanson Lumber Company, of Lewiston, has purchased of T. H. Deyarmond the Mio telephone line as far as Pennsylvania Crossing and will use it in connection with its camps in that vicinity. Frank Klooz will operate the remainder of the line.

DUNDEE, MICH.—The Dundee telephone exchange now has over 200 subscribers, including 60 farmers in the vicinity of Dundee. The exchange was established by F. W. Gradolph and began business April 1, 1902, with about 50 subscribers. The exchange enjoys a good patronage upon its toll line service, connecting with the U. S. line, and having access to the large independent exchanges of Toledo, Adrian, Jackson and other towns having independent service.

DETROIT, MICH.—The lines of the Detroit Co-operative Telephone Company and the Livingston County Home Telephone Company have been connected near Plymouth, and the Detroit concern now has connections with different independent circuits throughout the state by reason of this connection. The Co-operative Telephone Company has but slightly over 100 telephones in operation at present, the canvass for subscribers having been deferred until state telephone service could be offered. A switchboard sufficient to operate 12,000 telephones has been installed at 32 Michigan Avenue. The company consists of the following persons: President, C. M. Burton; vice-president, Max J. L. Towler; secretary, J. C. Danziger; treasurer, J. Ward Howland. A. A. Cowles has been elected manager. The shareholders of the company are all Detroiters, of whom the list shows 700 in all.

GRAND RAPIDS, MICH.—At the annual meeting of the stockholders of the Citizens' Telephone Company, of Grand Rapids, the officers elected were the same as those who have conducted the affairs of the company for the last year: C. F. Rood, president; Edward Fitzgerald, vice-president; W. J. Stuart, treasurer; E. B. Fisher, secretary; C. E. Tarte, general manager; Albert Stacey, superintendent of construction, and Edmund Land, electrician. The gross income during the year closed was $274,343.79, an increase of $76,232.81; the gross expenses of the past year for operation, management, general expenses, taxes, etc., were $76,066.60; for reconstruction, repairs, maintenance and depreciation, $100,499.46; after paying dividend requirements of two per cent. each quarter, aggregating $82,777.73 in the year, the sum of $15,000 was carried over in surplus, making the surplus account $55,231.48.

HASTINGS, MINN.—The Hastings Telephone Company has been incorporated by H. L. Sumption, Irving Todd, Jr., E. A. Whitford, John Heinen, W. E. Beerse and N. B. Gergen, with an authorized capital of $50,000.

PIPESTONE, MINN.—The Dell Rapids Telephone Company will construct 50 miles of rural lines in the vicinity of that place.

HANNIBAL, MO.—The Bluff City Telephone Company has had a cable laid across the Mississippi River at Hannibal to connect with telephone lines in Illinois.

JERSEY CITY, N. J.—The Atlantic & Pacific Telephone & Telegraph Company has been formed; capital stock $25,000. Corporators: Arthur Johns, E. P. Hervey, George U. I. Dwinell, all of Jersey City. The company is to operate telephone and telegraph lines.

MOUNT HOLLY, N. J.—The Farmers' Telephone & Telegraph Company, of Moorestown, has been incorporated in the County Clerk's office with Clayton Conrow, Horace Roberts, Ellis H. Rudderow, Edmund S. Holmes, Charles B. Jessup, Frederick Lippincott and George L. Holmes, all prominent farmers in the vicinity of Moorestown, as the incorporators. The authorized capital is $25,000.

LYNDONVILLE, N. Y.—The Lake Side Telephone Company has been formed; capital, $100,000. Directors: W. A. Tuttle and Grant Spaulding, Lyndonville; S. A. Coe, Yates.

NORTH TONAWANDA, N. Y.—The Niagara County Telephone Company operates a 600-drop board capacity and has 525 subscribers. The toll lines are all controlled by the Independent Union Telephone Company.

GRANVILLE, N. Y.—The Granville Telephone Company operates one 200-drop board, two of 100 each and three of 10 each. There are 700 subscribers and 100 miles of toll line. Several extensions are projected.

AUBURN, N. Y.—The Auburn Telephone Company has an automatic board of 450 drops, and a magneto board of 240 drops, with about 675 subscribers and 25 miles of toll line. The company will probably put in a new automatic system of the Automatic Electric Company, of Chicago, with capacity increased to 3,000.

CINCINNATI, OHIO.—The Board of Public Safety is taking steps towards placing the entire telephone system of the department underground.

COLUMBUS, OHIO.—The Putney Telephone Company, Shadyside, has been formed by C. W. Rodefer, John A. Futhey, W. P. Harris, H. B. Wilkinson, C. W. Danford. Capital stock, $1,000.

TOLEDO, OHIO.—The Toledo Telephone, Telegraph & Messenger Company has filed with the city solicitor and other city officials a formal application for permits to make the proper connections in its messenger and call box system, as required to do under the franchise ordinance granted it.

CINCINNATI, OHIO.—The Interstate Telephone Company has been incorporated at Columbus by a number of prominent Cincinnatians. The company was formed, the organizers say, to apply for a franchise to operate a telephone system in Cincinnati, and the City Council in the near future will be asked for a franchise. The incorporators of the company are Sol. P. Kineon, Oliver L. Perin, E. Zimmerman, R. H. Elliston and Frank K. Ludlow. The application for a charter states that the purpose of the company is to operate telephone and telegraph lines in Cincinnati and Dayton, Ohio, and the interlying counties. Wires are now being stretched in Kentucky and connections with wires to Louisville have been made. These over-river lines will form an adjunct to the Cincinnati company and it is thought that from $3,000,000 to $5,000,000 will be spent.

CHESTER, PA.—The United Telephone & Telegraph Company, of this city, which started business in opposition to the Bell system several years ago, has decided to put its wires underground.

BEAVER, PA.—The Beaver County Telephone Company, an independent concern, has been organized here, and application for a charter will be made. The company will install a system touching all important communities in the county, giving particular attention to the rural service. The capital will be $100,000.

WILKESBARRE, PA.—The Telephone Company of Wyoming County has begun the construction of a line from Centremoreland, Wyoming County, to Wyoming. From Centremoreland connection will be made with the Newton line, running to Mill City, Lake Winola and other points. The Newton line connects with the Bradford County line, which is a part of the New York State Company.

VERMILLION, S. D.—A stock company is proposed in Spirit Mound and Pleasant Valley townships to build a telephone line to Vermillion.

WORTHING, S. DAK.—The Worthing Electric Company is the latest telephone organization here. It begins with a 50-drop board and 35 subscribers. The company is capitalized at $5,000. President, M. Johnson; secretary, J. M. Montgomery; treasurer, A. W. Hawn; general manager, F. J. Hawn.

SAN ANTONIO, TEX.—The independent long distance telephone lines of Texas, known as the Commercial Telegraph & Telephone Company of Texas, has, as already stated, passed into the hands of H. E. Huntington, with Frank B. Smith, the originator of the independent system of this state, in charge. Mr. Huntington has acquired the system for approximately $4,000,000, and intends to invest $400,000 more in improvements and extensions. The system comprises 1,000 miles of toll lines in the heart of the cotton belt of the state, from San Antonio to Shreveport, La., and from Port Arthur to Waco.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company is planning another extension to its system in Weber County which will give the city a first-class connection with all precincts in the Ogden valley. Huntsville and Eden are already connected, and the Eden line will be extended to Liberty.

BURLINGTON, WIS.—The directors of the Burlington, Rochester & Kansville Telephone Company will increase their capital stock from $2,500 to $5,000.

ELECTRIC LIGHT AND POWER.

STOCKTON, CAL.—Bids will be received by the city clerk until September 14 for constructing a steam electric light plant.

LOS ANGELES, CAL.—A 30-year franchise to erect poles and string wires for the transmission of electrical energy has been granted to the Edison Electric Company. The company will operate at Claremont and Lordsburg.

SACRAMENTO, CAL.—J. A. Robinson has applied for a franchise to erect, construct and maintain along the public roads and streets of the city wires for transmitting electric current for lighting the city, and bids for said franchise will be received until Sept. 11.

NIMSHEW, CAL.—The power plant here will soon furnish electricity. The power house is situated on Butte creek, and after the water is used by the Nimshew plant will run as now, some five or six miles further to the Centerville plant, where 8,000-hp is now being generated. This new power house will be of steel so as to reduce to a minimum all danger of fire.

DENVER, COLO.—A syndicate of local capitalists, including Thos. J. Milner, have secured an option of 7,000 acres of land in Estes Park, to be used as a site for a power plant and reservoirs. The company also plans a number of electric railway lines in this vicinity. A project for the building of a large power plant and reservoirs at Estes Park has recently been made public. The syndicate, consisting of Denver capitalists, has secured an option on 7,000 acres of land in the park. On this site they propose to construct three of the largest reservoirs in the West, acquiring the water from the big Thompson River, and to establish a power plant of sufficient capacity to supply Denver and the surrounding towns.

COLORADO SPRINGS, COLO.—Geo. B. Tripp, general manager of the Colorado Springs Electric Company, states that his company has recently installed in its sub-station in the center of the city a 300-kw, 2300-volt, 60-cycle, three-phase generator, which is now being used as a synchronous motor to drive by means of line shafting 500-volt direct-current generators. During the winter months the machine will be used as a generator and will be steam driven. The Colorado Springs Electric Company is anticipating some trouble in securing coal for its power station, as the miners in the coal fields adjacent to the power plant have made demands on the operators for higher wages and shorter hours and if the demands are not acceded to a shut-down is probable. The Colorado Springs Electric Company supplies power to the three large ore-reduction mills just west of the city and they are about to shut down on account of the big Cripple Creek strike.

GRIFFIN, GA.—Mr. Wm. C. Whitner, of Rockhill, S. C., reports that the Towaliga Falls Power Company is to construct a power plant, dam and canal at Griffin, at a cost of $200,000.

BUFORD, GA.—An application for a charter has been filed with the Clerk of County Court, for the Winding Shoals Electric Power Company, which proposes to construct a dam on Chattahoochee River, five miles away, to build a circuit to this city and furnish power as well as light. H. I. Jacquish, of Gainesville; D. B. Stancliff, of Atlanta, and W. W. Gorham, of Chicago, Ill., are said to be interested.

GRIFFIN, GA.—Mr. W. G. Adams has been appointed to superintend a large contract for the Towaliga Falls Power Company, of Griffin, Ga. The contract, which is in charge of Mr. Whitner, is for a dam, race and power house to be built 15 miles from Griffin to light the city and run four or five large cotton mills in that place. These establishments now use steam. The work will cost about $200,000, and when completed will furnish 3,000-hp.

HOPEDALE, ILL.—Frank A. Albertson, of Pekin, has been granted a franchise for an electric light plant.

DIXON, ILL.—Henry C. Higgins, of Sterling, has secured a franchise for a gas and electric light plant at Dixon to cost about $150,000.

SPRINGFIELD, ILL.—The Springfield Light, Heat & Power Company has been formed to supply power; capital $10,000. Incorporators: E. G. Schmidt, Blufford Wilson, W. H. Brown.

SPRINGFIELD, ILL.—The Culver Construction Company, of Springfield, has secured the contract for the construction of the new power plant on E. Monroe Street, to cost about $60,000.

AURORA, ILL.—Electric machinery will probably supplant other motive power in the Fox River valley. Since the traction company's new power house at Batavia began business, there has been an abundance of power for the road and for any number of customers along the line. It is now proposed to furnish light and power to farm houses along the valley at a reasonable cost. Feed cutting, threshing and pumping by electrical power is also the intention of the company officials.

DURANT, IND. TER.—The citizens have voted to issue $85,000 bonds for water works, a sewage system and an electric light plant.

RICHMOND, IND.—Mr. S. O. Yates has secured the contract for an addition to the plant of the Richmond Heat & Light Company for $5,000. New machinery will also be added. Barton & Storrs are the owners.

SUMMITVILLE, IND.—The Madison Circuit Court judge has continued the order restraining the town board from purchasing the local electric light plant. The citizens object because of the necessary increased tax rate to complete the purchase.

WARSAW, IND.—The City Council has granted the Winona Electric Light & Water Company a 50-year franchise to construct and operate a complete electric light and power system, a hot-water heating plant and a water works with spring water for drinking.

INDIANAPOLIS, IND.—The Citizens' Heat & Light Company, of this city, obtained a franchise some time ago and agreed to have its plant in operation by Sept 1, 1903, but as yet it has not broken ground nor filed the $10,000 bond to assure the city of the carrying out of the contract.

RICHMOND, IND.—Attorney John T. Beasley, of Richmond, representing Bertron & Storrs, New York bankers, has completed the purchase of the Richmond (Ind.) Light, Heat and Power Company, formerly owned by Richmond and Dayton men. The eastern firm will make a number of improvements in the Richmond property. Richmond also has a municipal electric lighting plant.

CLARION, IA.—The citizens have voted to enlarge the electric light plant.

ELDORA, IA.—The Eldora Electric Light & Heating Company's fine plant has been sold by its owner, William S. Porter, to Ferris Bros., of Monmouth, Ill. It is said that the consideration was $40,000.

FT. RILEY, KAN.—The War Department has awarded the Junction City Electric Railway, Light & Ice Company the contract for lighting the streets and buildings. The company will enlarge its plant at Junction City and furnish current as far as the military reservation. The government will furnish all material at the post and will do the wiring. The cost of the work at the post and on the plant will be about $80,000.

JACKSON, KY.—The Jackson Electric Light & Power Company, recently incorporated in Delaware will immediately begin the erection of a power house.

SAG HARBOR, L. I.—The present electric light contract expires in September, and the village will then either purchase the present plant or build a municipal plant.

GLEN COVE, L. I.—The Glen Cove Light & Power Company, of Oyster Bay, has been incorporated, capital $15,000, by P. H. Grimm, J. W. Campbell and E. Luyster, of Glen Cove.

AUBURN, ME.—The Lyman Falls Power Company has been organized at Auburn, Me., to develop power on the Connecticut River; capital, $10,000. George B. Bearce, president, Lewiston, Me.; Fred W. McDonald, treasurer, Groverton, N. H.

PORTLAND, ME.—The Cuyamel Company has been organized at Portland, Me., for the purpose of doing a real estate and gas and electric light and heating business, with $500,000 capital stock, of which nothing is paid in. The officers are: President, William H. Green, of Portland, Me.; treasurer, Percy L. Andrews, of Portland, Me.

BALTIMORE, MD.—Bids are wanted Aug. 22 for replacing and repairing the storage batteries in the court house electric plant. Address Edward D. Preston.

UPTON, MASS.—The Upton Electric Company has been authorized to issue $7,500 new capital stock to construct a plant there.

DOUGLASS, MASS.—The State Gas & Electric Light Commission have allowed the Douglas Electric Company to issue new capital stock to the amount of $7,500 for the construction of its plant there.

GREENFIELD, MASS.—McCaghey & Linehan, of Little Falls, N. Y., have secured the contract for building the dam and power house at Gardners Falls for the Electric Light & Power Company. The General Electric Company will furnish the machinery, which will include two generators and two pairs of 27-inch horizontal water wheels. The plant will generate 1,100-hp.

PLYMOUTH, MICH.—The Michigan Electrical Company, of Detroit, has secured the contract for constructing an electric light plant for Plymouth.

ALPENA, MICH.—The Alpena Light, Heat & Power Company has been incorporated at Augusta for the business of electricians, capital $500,000, of which nothing is paid in. President, F. L. Dutton; treasurer, E. F. Whittum. Directors: F. L. Dutton, E. F. Whittum, C. L. Andrews, L. H. Tracy, of Augusta; Geo. P. Smith and J. P. Lindsay, of N. Tonawanda, N. Y.

ELY, MINN.—It was voted August 4 to issue $40,000 bonds for extending the water works and electric light plant.

TWO HARBORS, MINN.—Bids will be received Aug. 23 by the village trustees for changes and additions to the electric light and water plant consisting of a 150-kw direct-connected single phase alternator, a 250-hp high-speed compound condensing engine, condenser, heater and boiler feed pump, a 200-hp boiler and system of steam water and exhaust piping. Oscar Claussen is the consulting engineer, St. Paul.

ST. JOSEPH, MO.—The City Council is considering the question of constructing a municipal electric light plant to cost about $100,000.

LINCOLN, NEB.—A construction company has asked permission to construct a wing dam in the Niobrara river at a point near its mouth, for the purpose of carrying a part or all of the water through a channel around Niobrara island. The company intends to use the power thus gained to operate a system of water motors to generate electricity for power and lighting. It will require two years to complete the work, which will cost $150,000.

NIAGARA FALLS, N. Y.—Bids will be received Aug. 17 by the Common Council for furnishing to the city for a term of five years from Nov. 1, 1903, about 400 electric arc lights of 2,000-cp each. Jas. J. Mahoney is the chairman of the Committee on Public Lights.

CONCORD, N. C.—The Concord Light & Ice Company has been chartered with $75,000 capital.

SHELBY, N. C.—The Lily Mill & Power Company, of Shelby, has been chartered to manufacture cotton and operate an electric plant by water. The concern proposes to furnish electric power to a number of cotton mills at a figure cheaper than the mills are now expending for steam or water power.

ATHENS, OHIO.—Bids are wanted Aug. 24 for $15,000 electric light bonds. Address W. B. Golden.

WILLIAMSBURG, OHIO.—Bids are wanted Aug. 31 for $4,500 electric light bonds. Address Chas. Hoffman.

DAYTON, OHIO.—The Citizens' Heat, Light & Power Company, of Dayton, capital $10,000, has been incorporated.

ASTORIA, ORE.—A modern electric light plant is to be installed in the new Hume Mill and wires will be run for nearly 300 lights. The contract for in-

stalling the plant has been let to Trullinger & Hardesty, and work on it is to be begun at once.

AURORA, ORE.—The county court has granted a franchise to the Aurora Electric Company to construct and maintain an electric light line along the highways from Aurora to Gervais, for the purpose of transmitting electric power. The work on the new line must be completed within one year.

CANYON CITY, ORE.—H. H. Anderson, of Fredericksburg, Va., will soon start work on the construction of a large electric power plant at Sparta. The machinery has been shipped from Pittsburg. The plant will be constructed at a cost of $200,000. It will furnish power to Baker City, La Grande, Union, Sumpter and probably some other towns.

EUGENE, ORE.—The Lane County Electric Company is the name of a new corporation which will merge the Eugene Light Company into a larger and more progressive company. This new company will change the location of the Eugene electric light plant to Springfield within the next three months. The station will be maintained as a sub-supply station and probably to run the incandescent service in Eugene by night. The new plant will run all day as well as all night and furnish not only light for Eugene and Springfield, but power for the use of manufactories at both places. The company already has a franchise from the county for the right of way for the poles to Eugene. The poles are so set along the road that a trolley line attachment would need but the fastening on of supports for the wire.

MONONGAHELA, PA.—The Electric Light Company will reconstruct its plant, install new dynamos and a new gas engine. Mr. Wm. Ewing is superintendent.

WILMERDING, PA.—The Wilmerding Electric Light Company has been organized by Henry H. Lewis and David Goldstein to supply light, heat and power in Wilmerding and East McKeesport.

MIDDLETON, PA.—Ethelbert R. Heisey, cashier of the Dallastown National Bank, and George R. Heisey, of Marietta, representing a New York syndicate, have purchased the Red Lion Electric Light Company's plant for $10,000.

PHILADELPHIA, PA.—The James D. Lalor Engineering Company, of Philadelphia, consulting engineers, are equipping the Lippincott Building with a light and power plant, the contract for which was awarded to the Kingsbury, Samuel Electric Company, Baltimore, Md.

HARRISBURG, PA.—The new Paxtang Electric Company are making rapid progress with the work at their plant in South Harrisburg. A number of contracts for lighting business places and private residences have already been secured by the company and new ones are being received daily.

MYERSDALE, PA.—The borough council has granted a fifty-year franchise to "The People's Light, Heat & Power Company," for this borough. The company must be ready to furnish lights by Nov. 1, 1903, or forfeit its rights under this franchise. They must also furnish power both day and night, and a failure to do so 30 days in succession would forfeit their charter.

MONTREAL, QUE.—The City Council has decided to engage Mr. Chas. E. Phelps, of Baltimore, Md., to prepare plans, specifications and estimates of cost of building an underground system for all electric light, telegraph and telephone wires.

ANDERSON, S. C.—A syndicate has purchased a 6,600-hp water fall near Anderson, and will develop same for electrical purposes. Some of the stockholders of the Anderson Water, Light & Power Company are reported interested.

MEMPHIS, TENN.—The North River Electric Company has been formed to purchase, lease, maintain and operate water power for development of electricity, to operate mills, power and lighting plants. The incorporators are G. Richard Berlin, E. L. Berlin, J. J. Sharer, J. A. Riddell and Edward C. Martz. The capital stock is from $10,000 to $25,000.

MARLIN, TEX.—Engineer Fullenwider, of Austin, has made a survey of the falls of Brazos River near here, to determine the cost of an electric plant to be established there by a company of local capitalists.

READSBORO, VT.—Mr. W. S. Kelly, of Providence, R. I., is interested in the development of the water power of Howe's Pond and damming Deerfield River at Readsboro for electrical purposes. Some of the power will be transmitted to North Adams, Mass.

WYTHEVILLE, VA.—The Town Council has granted a franchise to the Stone Electric Light & Power Company for an electric light plant. Bids for construction will be received at once. A. F. Stone is the engineer in charge.

SEATTLE, WASH.—Bonds to the amount of $590,000 have been sold to be used for constructing the proposed municipal power and lighting system.

MARYSVILLE, WASH.—The council has granted the Everett Railway & Electric Company a franchise to light the city with electricity for a period of fifty years.

SEATTLE, WASH.—The time for receiving bids for the municipal electric light plant has been extended from Aug. 11 to Aug. 25. C. B. Bagley is the secretary of the Board of Public Works.

TACOMA, WASH.—Franchises have been granted to the Puget Sound Power Company, the Tacoma Industrial Company and the Snoqualmie Falls Power Company for the use of certain county roads in erecting electric lines for the transmission of power.

PALOUSE, WASH.—The Palouse Light & Power Company will have all the necessary machinery for their plant on the ground in the next few days, and it is announced by the management that the city will be lighted with electricity by the 15th of September.

HILLSBORO, WIS.—Mr. Myron Goodsell has secured a franchise for an electric light plant.

ASHLAND, WIS.—Prendergast & Clarkson, of Chicago, Ill., have secured the contract for a $30,000 electric plant for the Atlantic Dynamite Company.

THE ELECTRIC RAILWAY.

EUREKA, CAL.—Articles of incorporation of the Humboldt Transit Company have been filed to build 20 miles of electric railway in Eureka and an additional 54 miles to other towns in Humboldt County. The capital stock is $300,000, of which $75,000 has been subscribed. The directors are J. C. Bull, Jr., of Eureka; George Henderson, of Oakland; R. W. Bull and John C. Bull, of Arcata, and Charles P. Cutten, of Eureka.

LOS ANGELES, CAL.—Plans are being worked out for an electric road between Stockton and the Yosemite Valley, by Charles Gage, of Denver, representing a syndicate of Chicago, New York and Cleveland capitalists. Interested with Mr. Gage is Edwin De Haven, a Tonopah mining man. The present plan is to build a standard-gage road from Stockton to the valley by way of Chinese Camp, to Big Oak Flat, to Merced, to Hamilton, to Crocker.

HARTFORD, CONN.—The Crystal Lake Railway Company has organized and $50,000 of capital stock has been subscribed for. Charles E. Perkins is president of the company and Arthur Perkins, secretary and treasurer. It is the intention to build an electric railway from Crystal Lake to run north to the Massachusetts line, a distance of nine or ten miles.

ATLANTA, GA.—The Georgia Railway & Electric Company has purchased $250,000 of machinery for the equipment of two sub-stations. One will be erected near Decatur and the other will be built on the Marietta line. By means of these sub-stations the Georgia Railway & Electric Company will be in a position to furnish current for a distance of fifty miles from Atlanta. Work on the trolley line to Marietta has already begun and an extension of the Decatur line is contemplated.

DIXON, ILL.—The Dixon, Rock Falls & Southwestern Electric Railway, which is engaged in the preliminaries for an electric railway from Dixon to Rock Falls and nearby points, has elected officers as follows: G. H. T. Shaw, of Dixon, president; A. C. Hanley, vice-president; R. L. Leitch, secretary; O. E. Maxson, treasurer; H. L. Sheldon, attorney. The company has recently been granted a franchise in De Kalb.

INDIANAPOLIS, IND.—The Indianapolis, Danville & Rockville Traction Company has filed a petition with the County Commissioners for a franchise over and along the Rockville gravel road.

WINCHESTER, IND.—Surveys have been made by the Eastern Indiana Traction Company for its line, which extends from Hamilton, Ohio, to Marion, Ind. Construction will be begun about Sept. 1.

CHESTERTON, IND.—The City Council has granted a franchise to the Chicago, Indiana & Michigan Railway Company, which proposes to build an electric railway from Michigan City through Chesterton and other towns in Northwestern Indiana.

BELLEVILLE, IND.—The ordinance committee of the City Council has favorably reported an ordinance to grant the Morrison Express Company, of East St. Louis, a franchise to run freight and express cars over the tracks of the Belleville Railway system.

BLOOMINGTON, IND.—W. H. Schott, president of the electric light and heating plant in Bloomington, and also interested in the Indianapolis plant, will ask for a franchise from the Bedford City Council for an electric railway line through the quarry districts of Monroe and Lawrence counties.

INDIANAPOLIS, IND.—The Tipton, Frankfort & Attica Traction Company, which is to furnish connections with the Indianapolis, Northern & Northwestern trunk lines, has been incorporated; capital stock, $50,000. The directors are J. H. Fear, J. G. Clark, J. C. Shanklin, W. R. Dunham, G. M. Shortle, L. M. Green and Samuel Clark.

RICHMOND, IND.—The Indiana Eastern Traction Company will be the first electric line in this State to use the third-rail system. The overhead trolley will be used only in passing through cities. In the country the line will have its own enclosed right of way. Construction on this line, which will extend from Hamilton, Ohio, to Marion, Ind., via Richmond, will begin soon. It is the purpose of the company to build from Marion to Chicago.

INDIANAPOLIS IND.—An electric railway to connect this city with Toledo is being promoted by J. Morgan and J. L. Weadlock, of Toledo, Mr. Morgan is president of the Dayton, Ohio, Traction Company, and has been instrumental in building the network of lines about Dayton. The line will parallel the Wabash for some distance, connecting Toledo, Defiance, Napoleon and Van Wert, Ohio; Decatur, Hartford City, Alexandria and Noblesville, Ind.

ELWOOD, IND.—As to the incorporation of the Union Traction Coal Company, President McCulloch, of the Indiana Union Traction Company, says that the company was simply organized to hold coal leases and properties acquired in Sullivan County. It is understood that the plans of the Indiana Union Traction Company and its allied Indianapolis Traction & Terminal Company, both of which are interested in the new Plainfield line that is to be pushed through to Brazil, propose to penetrate not only the Sullivan County coal fields, but also those of City and Park counties.

DAVENPORT, IA.—The Davenport & Suburban Railway Company has filed amended articles of incorporation with the Scott County Recorder, increasing its capital stock from $500,000 to $1,400,000. The company intends to build an interurban line of railroads from Davenport to Muscatine.

COUNCIL BLUFFS, IA.—The Council Bluffs, Tabor & Southwestern Electric Railway Company has filed articles of incorporation. The headquarters are in Tabor, Fremont County; capital, $200,000; William J. Dobbs, president; Arthur S. West, secretary. The company is authorized to construct an interurban railway in Iowa, Missouri and Nebraska, and it is designated that the main line shall run through Pottawattamie, Mills and Fremont counties in Iowa, and Atchison, Nodaway, Holt, Andrews and Buchanan in Missouri.

KENTUCKY.—The Southern Kentucky Interurban Traction & Power Company has been formed with a capital of $125,000. Incorporators: C. W.

Courts, J. M. McCutcheon, J. C. Browder, J. R. Crewdson, R. P. Manly, R. R. Clark, J. W. Clark, H. S. McCutcheon and W. P. Bainbridge.

AMITYVILLE, L. I.—Wilkins K. Putnam has been granted a franchise to erect poles, string wires and lay tracks for the building of a cross-island trolley between the incorporate village limits in Amityville and the northerly limits of the town. The franchise is in line with others granted and calls for the laying of the rails, the building of the road under the direction of the commission, and within one year from the acceptance of the franchise. After ten years the town is to have two per cent. of the gross earnings of the company.

CARIBOU, ME.—At a special meeting Caribou voted to appropriate $25,000 toward the construction of an electric railway from Caribou to Washburn and Perham.

ELKTON, MD.—The Kent & Cecil Light, Power & Railway Company has awarded the Tennis Construction Company, of Philadelphia, the contract for building its new line from Chesapeake City to Elkton, Newark and Stanton.

SPRINGFIELD, MASS.—The Hoosac Valley Street Railway Company has received a decree granting a location for the railway on the west side of the State road south of the city.

WILLIAMSTOWN, MASS.—The selectmen of Williamstown, Mass., have received an application from Dr. S. L. Lloyd, of that town, for a franchise for an electric railway from Williamstown station to the Vermont State line, a distance of nearly three miles. It is the link for the connection of the proposed roads from Troy to the State line, and Bennington, Vt., to the State line, with the Hoosac Valley Company for North Adams and points in the southern part of the county.

FITCHBURG, MASS.—The Leominster, Shirley & Ayer Street Railway Company has been organized, with George W. Clifford, of Fitchburg, president; Wesley W. Sargent, superintendent; Charles F. Baker, of Fitchburg, clerk. The directors voted to make a 10 per cent assessment on the stock subscriptions and to begin at once the construction of the road. The company holds franchises for a line forming a connection between the Fitchburg & Leominster Street Railway and the proposed line from Ayer to Lowell. The franchises expire June 1, 1904.

MERIDA, MEX.—A street railway is to be constructed between the San Antonio hacienda and the town of Huhui by Dr. Domingo Evia, of this city.

HOUGHTON, MICH.—The Houghton County Street Railway Company expects to extend its lines from Lake Linden to Tamarack-Osceola mills, and possibly to Hancock.

IONIA, MICH.—Local capitalists are planning an electric railway from Ionia to Crystal Lake. The distance is 35 miles, and it is estimated that the railway can be built for $125 per foot, or $230,000. Ionia's Common Council has guaranteed a bonus of $5,000

VICKSBURG, MISS.—The Vicksburg Street Railway Company proposes extending its system to Wattersville, two miles.

ST. LOUIS, MO.—The certificate of incorporation of the Southern Illinois Electric Railway Company has been filed. The company is capitalized at $50,000, and its principal offices will be at Mount Vernon. The line will run from East St. Louis to a point at or near Maumee, on the Wabash River. The incorporators are John R. Piercy, George F. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, all of Mount Vernon.

BUTTE, MONT.—The Butte & Salmon River Electric Railway Company has been incorporated and capitalized at $2,000,000, of which $200,000 has been subscribed. The incorporators are T. B. Moss, H. W. Rowley, M. A. Arnold, T. D. O'Donnell and O. F. Goddard, all of Billings. The new road will traverse Silver Bow and Beaverhead counties, starting from Butte. It will run to Horse Prairie and thence through the Lemhi Pass into Idaho.

PATERSON, N. J.—The Paterson State Line Traction Company proposes to build a line from Paterson to the State line near Suffern. The company intends to run through Hawthorne, North Paterson, Midland Park, Ridgewood, Allendale and other villages.

ALEXANDRIA BAY, N. Y.—The St. Lawrence Electric Railway & Land Improvement Company, which owns and operates the trolley road between Alexandria Bay and Redwood is seriously contemplating building a 20-mile extension of the road to Watertown, taking in the route along Indian River and Butterfield Lake.

TOLEDO, OHIO.—Contractors have been invited to bid on the construction of the Ohio & Michigan Traction Company's line, 48 miles in length. Contracts will be awarded Sept. 1. The line will extend from Toledo to Ann Arbor, by way of Dundee, Milan and Petersburg.

CLEVELAND, OHIO.—W. S. Louge, representing Cleveland interests, has purchased the franchises and property of the Frankfort & Suburban Railway. The line comprises seven miles of road, which has not been in operation for about a year. Several miles of new track will be built.

CLEVELAND, OHIO.—A. E. Green, representing John B. Hoefgen, has made application for four new 3-cent fare routes as follows: On Denison Avenue, from Rhodes Avenue to the city limits; on Summit Street, from Erie to Seneca Streets; on Edgewater Boulevard, from Taylor Street to Lake Avenue; on Doan Street, from Wade Park Avenue to Ansel Avenue. The Cleveland Electric Railway has also asked for a franchise on Woodland Hills Avenue, Fairmont Street, Cedar Avenue, Dona Street, to the city limits, or by way of Quincy Street instead of by way of Cedar Avenue.

PETERBOROUGH, ONT.—A franchise for an electric railway has been granted to the Peterborough & Ashburnham Radial Electric Railway Company. The plans include Ashburnham, Lakefield, Young's Point and Chemong.

CHARLEROI, PA.—The Pittsburg & Charleroi, Street Railway Company has bought the property between Eleventh and Twelfth Streets for the purpose of constructing on it large car houses.

READING, PA.—Extension papers for the construction of the Pottstown & Suburban Railway Company in Berks County have been filed. This line will be 12 miles long. When completed this new line will form the connecting link uniting Reading and Philadelphia by trolley.

BUTLER, PA.—The Butler Passenger Railway will extend its lines to the edge of the new town of East Butler, three miles up the Bonnie Brook Valley. The officers and directors of the new company are D. H. Sutton, president; J. F. Anderson, J. H. Troutman, J. S. Campbell, F. H. Murphy and W. D. Brandon, directors.

PROVIDENCE, R. I.—E. K. Watson, of Warren, has been awarded the contract for building the sub-station for the Warren & Bristol branch of the Rhode Island Company at Barrington. The new station is to cost about $13,000.

NASHVILLE, TENN.—A charter has been granted the McMinnville, Woodbury & Nashville Railroad Company, with $10,000 capital stock. The incorporators are John M. Gant, Thomas S. Weaver, W. E. Gamble, M. D. Smallman and Walter S. Anderson. The line of the proposed road is from McMinnville through Woodbury, Jefferson, Smith's Springs to Nashville, with a branch from Smith's Springs to Donelson.

HOUSTON, TEX.—Work has begun on the addition to the power house of the Houston Electric Company. The addition, with the new machinery will entail an expenditure of $100,000. The plant is being enlarged primarily to provide power for the line to Harrisburg, which the company plans to construct next year.

NORTON, VA.—The Wise County Electric Light, Power & Transportation Company has been organized to build a road connecting practically all of the Wise County mining regions.

SPOKANE, WASH.—The Adams County Electric Transit Company expects to build a railway between Spokane and Washtuena.

WHATCOM, WASH.—The City Council has granted the Whatcom-Skagit Interurban Railway Company a franchise over certain streets desired to connect with 70 miles of electric railway which the company is to build between Mount Vernon and Deming, on the Noosack River.

NEW INDUSTRIAL COMPANIES.

AMERICAN DISTRICT TELEGRAPH COMPANY, of New York, has been formed under the laws of Delaware to acquire and operate telegraph lines; capital $20,000.

THE GLOBE ELECTRIC CONTROLLER COMPANY, of Amsterdam, has been formed with a capital of $25,000. Directors; R. W. Brown, J. J. Rowe, and R. G. Johnson, of Amsterdam.

THE MANHATTAN SWITCHBOARD COMPANY has been formed at East Orange, N. J., to manufacture electric switchboards, capital $50,000, by Charles Loeffler, Aug. Schramm, Coal H. Von Baur.

ELECTRIC CONTROLLERS.—The International Electric Controller Company has been incorporated in New York; capital $50,000. Directors: Mortimer Stiefel, R. W. Levy and E. M. Neary, New York.

THE STROUD TELEPHONE SPECIALTY COMPANY, of Chicago, Ill., has been incorporated to manufacture telephone and electrical apparatus, with a capital stock of $10,000. Incorporators: Harold D. Stroud, J. C. Whipple and Harry Flyton.

PORTLAND, ME.—The American Signal Company has been organized to deal in electrical and mechanical signals. Capital $1,000,000, $50 paid in. Par value, $10. Promotors: James T. Stevens, South Baintree, Mass.; Albert M. Bullard, Somerville, Mass.; A. J. Desmond, president; Harry L. Crom, treasurer; H. P. Sweetser, Portland.

THE WESCO COMPANY has been incorporated under the laws of Maine for making and dealing in electric motors, dynamos and appliances; capital, $1,000,000, of which nothing is paid in. President, M. W. Baldwin; treasurer, J. J. Hernan. Directors: M. W. Baldwin, J. J. Hernan, A. S. Conant and J. E. Mantner, all of Portland, Me.

HAMILTON ELECTRIC COMPANY.—This concern has been formed under the laws of Maine for making and dealing in electrical apparatus; capital, $200,000, of which nothing is paid in. President, J. G. Robinson, Melrose, Mass.; treasurer, E. W. Freeman, Portland, Me. Directors: J. G. Robinson, Melrose, Mass.; E. W. Farnum, Portland, Me.; M. J. Session, Portland, Me.; and Thos. Hamilton, Boston, Mass.

PHILADELPHIA, PA.—The Susquehanna Power Company, recently incorporated for the purpose of harnessing the water power of the Susquehanna River, and conveying current to Baltimore, has secured subscriptions to nearly $10,000,000 of its capital and is about to sign a contract with the General Electric Company for electrical machinery involving $2,500,000 to $3,000,000.

HENRY ELECTRIC EQUIPMENT COMPANY.—It is stated that the Henry Electric Equipment Company, incorporated under the laws of Colorado, with a capital stock of $1,000,000, will erect its plant at Springfield, Ohio. C. F. Elliott, president of the company, has been looking over sites and the Commercial Club will take hold of the enterprise. The main offices of the company will be in Chicago. General A. S. Bushnell, former Governor of Ohio, is interested in the company.

YOUNGSTOWN, OHIO.—The General Electric & Manufacturing Company has been incorporated to succeed the Central Electric & Manufacturing Company. The officers are the same as those of the old company, the only change being in the name. The new company purchased the business and plant of the Warren Brass Company, of Warren. The company has secured a site for a factory at Struthers, but it is probable that the Warren factory will be retained. Edward S. Whiting has become general manager of the new company.

LEGAL.

WESTERN UNION AND LABOR.—Special Master in Chancery H. N. Blake, at Butte, Mont., has reported to the Federal Court his findings in the hearing of the Western Union Telegraph Company against the American Labor Union and other labor unions of Butte for an injunction to restrain the labor organizations from interfering with the business of the telegraph company, because the latter had been declared unfair in a strike of messenger boys. Judge Blake recommended that a permanent injunction be granted the Western Union.

CHICAGO STREET CAR LITIGATION.—Two bills have been filed in the Superior Court, at Chicago, asking for the appointment of receivers for the North Chicago Street Railroad Company and the West Chicago Street Railroad Company. The actions are begun by bondholders in the two companies, who declare that the action in the United States court against the Union Traction Company and the two subsidiary companies will not afford the proper protection to the creditors of the two lesser companies.

TELEPHONE SUBSCRIBER DISCONNECTION.—Reversing a decision in favor of a physician who brought suit against the Cumberland Tel. & Tel. Company, the court of appeals of Kentucky held that the physician could not recover primitive damages. It appears that by mistake, a physician's telephone was disconnected for nonpayment of rent when the rent was in fact paid. During the 18 hours that the telephone was disconnected persons endeavoring to reach the physician by telephone were informed the telephone had been disconnected for nonpayment of rent. The physician suffered no pecuniary injury. The appeal court also decided that where, by mistake, a telephone is disconnected for nonpayment of rent when it is in fact paid, and the subscriber suffers no pecuniary injury, the measure of damages is the amount paid for the service for the time the telephone was disconnected, taking as a basis the amount paid per month.

WATER POWER RIGHTS.—The Supreme Court of Dakota, in modifying but affirming a judgment in favor of the plaintiffs in the suit of the Lone Tree Ditch Company against the Rapid City Elec. & Gas Light Company, decided among other points as follows: Comp. Laws, § 5593, limiting the time for the commencement of an action to recover damages for land overflown by reason of a mill-dam, has no application to an action to restrain one from maintaining a dam, or interfering thereby with prior water rights. 3. In an action to restrain defendant from maintaining a dam or from interfering with plaintiff's use of the water for irrigation and domestic purposes, the evidence being examined, it was held to show that defendant's custom of holding the water during the day and letting it down in large quantities during the night was the immediate cause of an injury to plaintiff, who used the water for irrigating and domestic purposes. 4. Where the waters of a stream, across which a dam had been constructed, were capable of driving the machinery there situated only when the water was retained during the day and discharged at night, and where this procedure was the only thing in connection with the use of the dam of which the owners of prior water rights could justly complain, an injunction against the maintenance of the dam was not justified, a restraining of the injurious practice being sufficient.

HAVERHILL COMPETITIVE LIGHTING.—The Massachusetts Board of Gas and Electric Commissioners has handed down a decision, sustaining the appeal of the Haverhill Electric Company, and annulling the action of the Haverhill Board of Aldermen in granting a franchise to and contracting with the Haverhill Illuminating Company for furnishing electric lighting to the city. This was an appeal by the Haverhill Electric Company from a decision of the Board of Aldermen, of Haverhill, in favor of the Haverhill Illuminating Company. It was held that there appeared to be nothing in either the management or the proposed equipment of the new company which would enable it for any length of time to successfully supply electricity at lower prices or with greater public satisfaction than might be done by the existing company. There was no offer by the new company relative to commercial lighting either as to prices or volume of business to be undertaken, except that it would probably desire to do such business in the central and more thickly settled sections of the city. There was no claim by the new company that it would supply either commercial lights or power at less than the prices now charged. The present company has invested in the business about $250,000, while the new company proposes to invest about $150,000. It is more than probable that the proposed investment would be found too small to carry on a business of equal volume with that now done, and it is, therefore, very doubtful if the new company contemplates an equal extension of business. The new company rested its case almost entirely upon the fact that it had offered to do street lighting at a price which would be about $6,000 per year less than the offer of the existing company. It is suggested in the decision that the old company revise its own figures of service to the city.

PERSONAL.

MR. GEORGE WESTINGHOUSE has returned from England this week on *Kaiser Wilhelm II.*

MR. J. J. WELCH, formerly in charge of the Paterson district of the New York & New Jersey Telephone Company, now takes the management of the Jersey City district, and H. I. Sergeant goes to Paterson in his place.

MR. JOHN B. ORR, late partner of the electrical engineering and contracting firm of James Mitchell & Company, of Rio de Janeiro, Brazil, has opened offices in the city named to make a specialty of handling American electrical machinery for lighting, traction and general power purposes.

LIEUT. LUIZ DIAS CARNEIRO, of the Brazilian Navy, who has been visiting Europe, is now in this country for a few months with the object of seeing something of the work of American electrical and other manufacturers as well as of studying some of the latest civil and electrical engineering.

MR. HENRY J. HALLBERG, lately with the General Incandescent Arc Light Company, of New York, has left for Cincinnati, to take up actively at once his duties as superintendent of the electric lighting department of the Cincinnati Gas & Electric Company, which is to make extensive additions to its system.

PROF. R. A. FESSENDEN has accepted the position of consulting electrical engineer with the Collins Marine Wireless Telephone Company. Prof. Fessenden is continuing work at Old Point Comfort on his wireless telegraph system, which is stated to have about reached the stage of commercial application.

MR. ARTHUR WILLIAMS, past president of the New York Electrical Society, has just returned from a trip to Europe taken for rest and to observe in behalf of the New York Edison Company, recent methods of light and power business. He will present a paper on the subject next month to the Edison convention.

MR. C. L. EDGAR, president of the Edison Electric Illuminating Company, of Boston, and president of the National Electric Light Association, has been spending the past week in New York at the association offices, clearing up matters and arranging for the convention next May in Boston. A great deal of effective work on plan and scope is being done.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the Westinghouse and allied interests on the west coast of South America returned to New York this week from Panama. He is about to place further substantial orders for the electrical equipment of Chilian nitrate plants. Mr. Robinson is making his headquarters with William E. Peck Company, 116 Broad Street.

MR. C. T. MALCOLMSON, the electrical engineer, who has lately been on the staff of the department of machinery at the St. Louis Exposition has resigned to accept the position of chief engineer to the important Lanyon Zinc Company, of Iola, Kan., etc., of which Mr. F. E. Drake is president. The zinc industry affords an excellent opportunity to Mr. Malcolmson's experience and ability.

MR. C. M. GOULD, of the Gould Storage Battery Company, was out in his automobile last week with Mrs. Gould, near his summer residence at Bayside, Long Island, when a startled horse caused the machine to be overturned with serious injury to both Mr. and Mrs. Gould. We are very glad to learn that they are doing well in the doctor's hands, and on the way to recovery from the results of the accident.

MR. JAMES BURKE, the dynamo electric designing engineer, who has been abroad some six years, has returned to this country and has taken an office in the St. Paul Building, New York City. He will still spend part of his time abroad each year. He has been very actively occupied at the Bergmann Dynamo Works, in Germany, which has sent his apparatus all over Europe, and he will still act as consulting engineer for those interests.

MR. SAMUEL INSULL, president of the Chicago Edison Company and of the General Incandescent Arc Light Company, was in New York last week. The "G. I." Company, whose real estate was recently sold to the Pennsylvania Railroad and whose business has been acquired from Mr. Insull by the General Electric Company, has transferred the bulk of its manufacturing plant to the Stanley shops at Pittsfield, and Mr. Insull has been busy cleaning up the details of these important deals.

MISS BOGART, manager of the New York offices in the Havemeyer Building of the electrical engineering and contracting firm of Macartney, McElroy & Company, Limited, is expected back from a short European trip next week. On her arrival here, it is expected that some substantial contracts will be given out for equipment, etc., in connection with the Malta electric traction system for the construction and equipment of which the British concern recently secured the contract.

MR. T. A. EDISON has perfected his commercial phonograph for taking court testimony and other dictation. The record used is nine inches long and capable of taking several "letters." It can be shaved 175 times, making it as cheap as letter paper, and there is a mechanism controlled by the foot of the operator taking dictation from it which stops and starts the machine at the end of a phrase, sentence, or paragraph the operator is capable of remembering while transcribing and a device for making it repeat a given number of words. It is said that with one pair of machines—one for recording, the other for reproducing—one typewriter can, by keeping steadily at his machine, do the work of eight under the present system.

MR. I. L. STOREY, the well-known inventor and motor designer, joined the forces of the Magneto Electric Company, of Amsterdam, N. Y., a few months ago, and since that time has been very busy in developing a line of motors from one up to ten horse power. The company has increased its facilities in order to place these on the market in large quantities, and Mr. Storey when on a visit to New York this week found an immediate appreciation of his new apparatus, securing at once a number of excellent orders. The curves of output and efficiency shown by him to his friends are most striking. Mr. Storey also intimated that the company, which has active men and plenty of capital behind it, would also soon be ready with some other valuable specialties in the electric lighting and power field.

PROF. A. G. BELL.—At Halifax, N. S., on August 11, Prof. Alexander Graham Bell made a statement about his aerial navigation experiments with kites at his Summer home. He denied the report that he had an airship ready to be launched, but he expects to have a flying machine in successful operation before the Summer is over. Asked whether it would be possible to work in a calm a flying machine built on the kite principle, Prof. Bell replied: "The invention of a flying machine is a possibility for the near future. No one who has noticed the flight of birds can for one moment doubt the possibility of flight by a body specifically heavier than the air. I am convinced that the flying machine of the future certainly will be built on the aeroplane theory. A machine capable of combating atmospheric conditions successfully must be heavier than the air, and to a certain extent capable of utilizing these at-

mospheric conditions." Prof. Bell will now spend his time mostly in experimenting on minor details with the view of giving his machine a greater rigidity of frame at less weight.

MR. STEPHEN T. LOCKWOOD, of Buffalo, N. Y., is interested in a company being formed there to extract radium from uranium ores that are being worked in Grand County, Utah. The Utah bed is of carnotite, a combination of uranium, vanadium, iron, copper and barium, and as later researches showed, radium and polonium. Prof. Becquerel's announcement of the radio-activity of uranium, followed as it was by the discovery of radium, started Mr. Lockwood to thinking whether the uranium from Utah would not give up radium as well as the uranium extracted from the flinty pitchblende. The carnotite from Utah was much easier to work than the pitchblende. They enlisted the attention of the scientists in the eastern universities. Great aid was given them from the laboratories of Columbia and Princeton. "And at last a sample of radium-barium compound was produced which showed a potentiality of 365 on the delicate electroscope in Columbia University." A testing plant will soon be built at Buffalo with a capacity for the reduction of two tons of ore a day. Such a plant would turn out daily 100 pounds of uranium oxide, worth $2 a pound; 10,000 grammes of crude radium-barium compound of ten units activity due to the radium, worth about two cents a gramme, and 100 pounds of other metallic residues known to contain another radiant metal, polonium. The crude radium-barium product will be removed to a laboratory and there reduced to the ultimate radium.

MR. E. W. COLEMAN.—We have not the pleasure of knowing Mr. Coleman, but after reading the subjoined from the *Carrollton Free Press* feel that it would be a privilege to do so: Tuesday morning, while burrowing through a carload of exchanges, Ed. W. Coleman, manager of the Bell Telephone Company here, came into our sanctum. Both of our chairs were in use at the time of his arrival, but we winked at the local man, and he immediately remembered that he had neglected to get the real estate transfers and at once "hiked" for the Recorder's office. We were then at liberty to ask Mr. Coleman to "sit down." We did. He did. Mr. Coleman is a printer by trade, and naturally became reminiscent during his visit. He told us that there should be nothing in a paper that could not be read aloud in the circle where characters are made and where sweetness and delicacy and purity rule absolute. Up to this time we appreciated every word that he had spoken and thought that he was going to "thaw" for a year in advance; but within the next fifteen minutes he had changed the subject entirely and had convinced us "beyond the existence of a reasonable doubt" that in order to successfully run a newspaper it was necessary to place a telephone in our office. Mr. Coleman carries his head high on the telephone boulevard and never shies at independent companies or cuss words. He is a good newspaper man and a good telephone man. When he walks down the street everybody owing telephone rents grins and hurries on and Helfrich's sign of the "big watch" wig-wags in the joyousness of his presence. To have him near cures dyspepsia, removes warts, abrogates that tired feeling and charges the heyday in the blood with rejuvenation and renascence.

Trade Notes.

LAMBERT SCHMIDT TELEPHONES.—The Lambert Schmidt Telephone Mfg. Company has disbanded its New York office and consolidated its selling department with its factory, at 85 Maple Street, Weehawken, N. J., the mailing address being Station 1, Hoboken, N. J.

ROCHESTER ELECTRIC MOTOR COMPANY, of Rochester, N. Y., have issued a neat illustrated catalogue of their direct current factory motors of various styles and sizes and in different positions. Details of construction are also shown, such as coils, armatures, bearings, etc., and there are some characteristic efficiency curves.

REYNOLDS CORLISS ENGINES.—The Allis Chalmers Company have issued a very handsome oblong catalogue relative to their Reynolds Corliss engines. Nearly 200 pages are occupied by data, descriptions of types and details, and views of some fine installations in different parts of the world, in electric and other heavy classes of service.

A NEW TELEPHONE CATALOGUE and up-to-date price list for same have just been issued and are now being sent out by the Electric Appliance Company, Chicago. Any one in the telephone business who has been missed in the distribution will receive a copy of this catalogue by writing to the Electric Appliance Company, 92 W. Van Buren St., Chicago.

PUMPING BY COMPRESSED AIR is the title of a most interesting and well prepared pamphlet just issued by the Pneumatic Engineering Company, of 128 Broadway, New York City, which controls the Titus "air lift" system. Details are given of the apparatus, and a number of handsome views are presented of plants where the company's system and apparatus is in use.

JEFFREY MFG. COMPANY, Columbus, Ohio, have issued a circular, No. 73, describing in a brief way their various lines of manufacture. Their new complete catalogue of 376 pages is now ready for distribution and should be applied for, as a valuable and useful piece of trade literature devoted specially to coal mining apparatus, chain belting, elevating and conveying machinery, etc.

NEW YORK SAFETY STEAM POWER COMPANY, of 113 Liberty Street, New York City, have just issued a very neat new catalogue on their automatic engines. It illustrates and describes in excellent manner both the horizontal and the vertical types, and gives data as to many details. The sectional views of the engines are admirable, and full particulars are given as to sizes, etc.

CENTRAL ENERGY TELEPHONES.—The Stromberg-Carlson Telephone Mfg. Company, of Chicago, Rochester, etc., have just issued Bulletin No. 5 in their useful and valuable series of pamphlets on telephone apparatus. This number is devoted to central energy telephones, of which it shows a great variety, assembled and in detail, with the utmost clearness and accuracy. A great deal of data is given also as to telephone parts, including receivers, transmitters, arresters, etc.

A RUBEROID ALBUM is the title of a handsome little pamphlet issued by the Standard Paint Company, of 100 William Street, New York City, to celebrate the twelfth year of Ruberoid roofing, and to give an idea of the large amount of important work that has been done with this material. A large number of views are shown of buildings protected by this roofing, and some interesting details are given as to its composition and ingredients. There is also a profusion of convincing testimonials.

A WIRELESS TELEGRAPH SCHOOL.—The Thos. E. Clark Wireless Telegraph-Telephone Company, Detroit and Pontiac, Mich., have recently instituted a wireless telegraph school for the benefit of those who desire to become familiar with the Clark apparatus. This school is under the tutorship of Capt. R. W. Holmes, an expert wireless telegraph operator. This is an opportunity for students to become familiar with the latest electrical apparatus and also to acquire a knowledge of the instruments which would be impossible to obtain unless by purchasing the student sets.

"SMALL TOOLS" is the title of a handy little 16mo pamphlet issued by the Pratt & Whitney Company in behalf of their small tool department at Hartford, Conn. Its 182 pages enumerate, describe and illustrate a large variety of gauges, taps, drills, reamers, milling cutters, taper pins, dies, etc. The section and data with regard to gauges are most interesting showing how far standardization of screws, bolts, gauges, etc., of various kinds has already been pushed, with enormous gain and economy. The concern has issued also, in separate form two pamphlets, one on new model turret lathes and the other on thread milling machinery.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., resumed lamp manufacturing August 17, after an interval of two weeks. During this period the making of incandescent lamps was entirely stopped, a new warehouse was erected, and the stock of lamps which was formerly carried in the factory was moved to the new building. In the factory, new machinery was then added, occupying the space formerly given over to stock; and with this new machinery the company has increased its output about 25 per cent. This increase has been made necessary by the fact that the Germania lamps have experienced a demand which can only be accounted for by the thorough workmanship that is put into each and the entire satisfaction that they all give.

CONDUIT FOR INTERBOROUGH SUBWAY CARS.—A recent testimony to the value of flexible metallic conduit was made by Vice-president and General Manager Bryan, of the Interborough Rapid Transit Company, in an interview published in the New York *Sun*, August 12th. Speaking of the fireproof construction of the new cars for the subway, and the impossibility of the Paris accident being repeated in New York, he says, according to the New York *Sun:* "The wiring for lighting the cars is one roof away from the passengers. Two small wires are insulated with asbestos and carried in conduits of flexible metal." The flexible metallic conduit which he refers to is that manufactured by the Sprague Electric Company, who received the order. This type of conduit is admirable for car wiring as well as the wiring of buildings where thorough protection to wires and insulation is essential. Its flexibility is such that it can be bent around corners and over obstructions with ease, the energy required to bend it being no more than is required to bend a Manila rope of the same diameter. No elbows, therefore, are required and the installation is reduced to absolute simplicity. It is self-evident that this type of conduit is well fitted to car wiring, and it is gratifying to note that the Interborough Company has taken a step forward in improving upon the hitherto careless methods of car wiring.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 11, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

735,708. ELECTRIC ARC LAMP; T. L. Carbone, Berlin, Germany. App. filed May 8, 1902. The arc is maintained in a constant magnetic field, in order to steady it.

735,714. CONTROLLING SYSTEM FOR RAILWAY VEHICLES OR TRAINS; J. L. Crouse, New York, N. Y. App. filed Feb. 20, 1903. Means for interrupting the power circuit and returning the motor controller drum to its initial position when the brakes are applied.

735,755. ELECTROMAGNET; A. Green, Rochester, N. Y. App. filed Nov. 14, 1901. Two cup-shaped parts adapted to telescope each other; one of them carrying a coil and having grooved pole-pieces which, it is alleged, increases the magnetic attraction.

735,760. METHOD OF MAKING ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed May 18, 1901. The end of the glower is held in a fusing arc and its image is at the same time thrown upon a screen, so that its formation can be easily watched, and the glower removed from the arc, when the image indicates that it is of the desired size.

735,761. APPARATUS FOR TREATING ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed July 12, 1901. A machine by which the preceding method may be practised.

735,773. METHOD OF MAKING FIBER INSULATING LININGS FOR INCANDESCENT LAMP SOCKETS; O. E. Kenney, Toledo, Ohio. App. filed Dec. 31, 1902. The fiber cylinder is subjected to a pressing and vulcanizing process to prevent it from swelling, or otherwise changing its size or shape after insertion in the lamp socket.

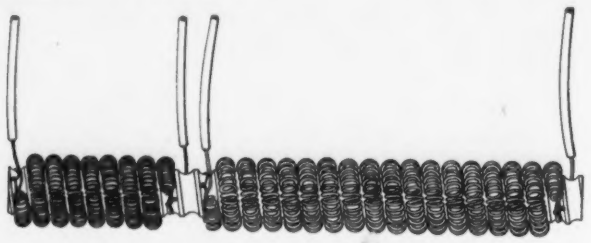
735,786. SYNCHRONIZING APPARATUS FOR ELECTRICAL MACHINES; P. M. Lincoln, Pittsburg, Pa. App. filed Dec. 29, 1902. Comprises two stationary members and two rotatable members having concentric shafts in connection with a single dial plate, and two indexes respectively connected to and actuated by said shafts.

735,798. ELECTRIC HEATER; J. F. McElroy, Albany, N. Y. App. filed April 30, 1903. An electric heater having its heating coil divided into sections of different intensity, each section occupying a longitudinal space on the core, proportionate to its fraction of the total heat intensity.

735,808. COMPOSITION OF MATTER FOR BATTERY-ELECTROLYTES; William Peto and James William Thomas Cadett, Ashlead, England. App. March 14, 1903. (See page 303.)

735,817. APPARATUS FOR THE PURIFICATION OF WATER; Samuel S. Pridham, Newark, N. J. App. filed July 20, 1901. (See page 303.)

735,820. METHOD OF TREATING LEAD PLATES FOR USE IN SECONDARY BATTERIES; Charles J. Reed, Philadelphia, Pa. App. filed Feb. 1, 1902. (See page 304.)



735,798.—Electric Heater.

735,821. CLAMPING DEVICE FOR ELECTRIC METAL WORKING APPARATUS; A. F. Rietzel, Lynn, Mass. App. filed July 28, 1902. This invention relates to the clamping devices which are especially designed for use with heavy work and readily adjustable for different kinds of work.

735,841. ELECTRIC SWITCH; H. O. Swoboda, East Orange, N. J. App. filed Sept. 6, 1902. Details.

735,893. CONTROL OF ELECTRIC MOTORS; F. A. Merrick, Johnstown, Pa. App. filed Jan. 14, 1901. A method of carrying a pair of motors across an open circuit position of the controller, consisting in making the period of open circuit of brief duration, and preceding and following such open circuit position by circuit relations, whose connections can be super-imposed without producing short circuits or other undesirable circuit conditions.

735,922. TICKER ATTACHMENT; R. D. Westcote, New York, N. Y. App. filed Aug. 18, 1902. A trough arranged as a continuation of the paper outlet from the ticker, and over which the tape runs so that it can be readily observed.

735,966. ELECTRIC SWITCH; C. C. Gould, Philadelphia, Pa. App. filed March 19, 1902. Details of construction.

735,971. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed April 18, 1902. (See page 304.)

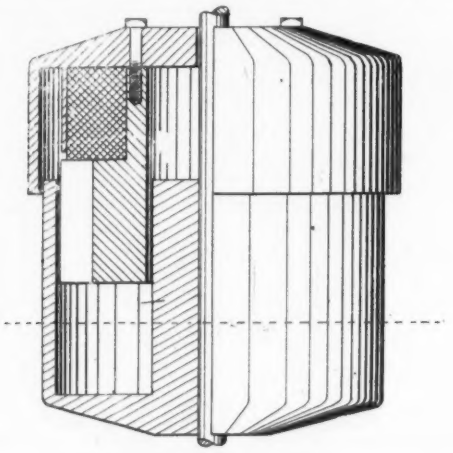
735,990. REGULATING SYSTEM OF ELECTRICAL DISTRIBUTION; Larmar Lyndon, New York, N. Y. App. filed Aug. 16, 1902. (See page 304.)

736,006. TRAVELING CONNECTOR FOR THIRD RAIL ELECTRIC SYSTEMS; J. W. Perkins, San Jose, Cal. App. filed Sept. 23, 1902. The third rail is placed between the traction rails and protected by filling pieces inserted each side of it, which bring the surface of the road bed substantially level with the tread of the traction rail, while the third rail is below this level.

736,016. PROCESS OF GENERATING ELECTRICITY; J. H. Reid, East Orange, N. J. App. filed May 17, 1902. Fuel gas is conducted into a porous receptacle, pervious to gas, but impervious to liquid; at the other side of the receptacle there is a heated liquid electrolyte to which oxygen is supplied. The external receptacle and the porous cup are the electrodes.

736,017. GAS-BATTERY; J. H. Reid, Newark, N. J. (See above.)

736,019. PROTECTIVE FUSE APPARATUS; W. L. Richards, Malden, Mass. App. filed July 26, 1902. A fuse tube having a small bore, and comparatively thick walls composed of an outer tube made of a wound



735,755.—Electromagnet.

strip of fiber, and an inner tube of similar material, fitting tightly therein, the whole structure forming a strong enclosure.

736,020. APPARATUS FOR THE ELECTROLYSIS OF FUSED SUBSTANCES; Charles W. Roepper, Philadelphia, Pa. App. filed Sept. 27, 1898. (See page 303.)

736,041. CIRCUIT BREAKER; E. P. Warner, Chicago, Ill. App. filed Dec. 20, 1902. Details.

736,048. COMMUTATOR BRUSH; C. Wirt, Philadelphia, Pa. App. filed Jan. 31, 1900. A large number of thin metal plates, or gauze, alternating with layers of poor conducting material.

736,049. ELECTRIC FUSE BOX; J. J. Wood, Fort Wayne, Ind. App. filed Feb. 24, 1903. The fuse is carried in a groove over the end of a plug, which is inserted in a chamber longer in one direction than in the other, the chamber being thereby divided into two compartments by the plug, one half of the fuse being in each compartment.

736,050. ELECTRICAL SIGNALING SYSTEM; J. L. Wrenn, Washington, D. C. App. filed May 11, 1903. Details.

736,055. ELECTROMAGNETIC RAILWAY SWITCH; R. A. Baldwin, South Norwalk, Conn. App. filed Dec. 18, 1902. An improvement on the Baldwin railway switch, affording a means for locking the switch point in either of its positions, and for automatically releasing the lock when the switch is reversed.

736,063. ELECTRICAL SWITCH; R. L. Border, Pittsburg, Pa. App. filed March 24, 1902. The invention relates to a circuit closer to be attached to a trolley wire, and is shown in connection with the operation of a track switchpoint.

736,069. ELECTRIC INCANDESCENT LAMP; C. H. Carter, Brooklyn, N. Y. App. filed Oct. 15, 1902. A construction of socket for a multi-filament lamp, in which the lamp has a longitudinal movement to engage with the socket, such movement being permitted to a limited extent without detaching the lamp from the socket, and for the purpose of cutting in and out the various filaments.

736,086. X-RAY TUBE; R. Friedlander, Chicago, Ill. App. filed March 14, 1903. A ray-tube having an extension neck, adapted for insertion in the mouth to directly apply the rays emanating from the anode terminal.

736,120. ELECTRIC BRAKE; G. A. Le Fevre, New York, N. Y. App. filed June 21, 1902. Separate motors are used on each car of the train for setting the brakes. The motors are electrically connected together, and automatic means are provided for cutting out each motor independent of the other as a predetermined pressure of its brakes is reached.

736,125. STORAGE BATTERY; Abraham V. Meserole, New York, N. Y. App. filed May 14, 1903. (See page 303.)

736,127. MERCURY SAFETY ATTACHMENT FOR ELECTRIC CIRCUITS; E. Mies, Büdesheim, Germany. App. filed Dec. 31, 1901. A safety device for electric circuits comprising a capillary tube containing mercury, which forms a portion of a circuit and means on the tube, actuated by external pressure to restore the mercury to normal condition, should it be vaporized by excessive current.

736,154. ELECTRIC BRUSH; C. T. Richmond, Cleveland, Ohio. App. filed May 10, 1902. A carbon brush having wire gauze embedded therein, and

736,177.—Electrical Coil.

rods of solid lubricating material extending part way through the contact end of the brush.

736,177. ELECTRICAL COIL; R. Varley, Providence, R. I. App. filed May 15, 1903. A magnet coil in which each layer of wire is wound upon a smooth wrapping of paper, the lateral edges of which project beyond the end turns of the layer, and are there thickened to furnish a stop which prevents the end turn from falling out.

736,178. PROCESS OF COVERING WIRE; R. Varley, Providence, R. I. App. filed May 20, 1903. In order to place a wrapping of fragile asbestos tape upon the wire, it is wound in conjunction with a paper backing which furnishes the necessary support to resist the strain encountered in the winding operation, afterwards the paper is removed by unwrapping.

736,204. REDUCTION OF NITRO AND AZO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Sept. 24, 1900. (See page 303.)

736,205. REDUCTION OF NITRO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Sept. 24, 1900. (See page 303.)

736,206. REDUCTION OF AROMATIC NITRO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Dec. 14, 1901. (See page 303.)

736,216. SEPARATOR FOR SECONDARY BATTERIES; Absolam F. Clark, Philadelphia, Pa. App. filed July 22, 1901. (See page 304.)

736,217. SECONDARY-BATTERY PLATE AND METHOD OF MAKING SAME; Absolam F. Clark, Philadelphia, Pa. App. filed Dec. 28, 1901. (See page 304.)

736,248. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed April 18, 1902. (See page 304.)

736,280. REGULATING SYSTEM OF ELECTRIC DISTRIBUTION; Lamar Lynden, New York, N. Y. App. filed Sept. 18, 1902. (See page 304.)

736,292. ALTERNATING CURRENT MOTOR; F. L. O'Bryan, Winston-Salem, N. C. App. filed Dec. 20, 1902. A starting coil comprising a bar, bent upon itself and connected at its end by a yoke or bridge piece.

736,297. RHEOSTAT AND RESISTANCE ELEMENT THEREFOR; C. J. Reed, Philadelphia, Pa. App. filed June 3, 1902. The resistance coils are of helically wound wire, the resistance of which is varied by compressing the helix endwise.

736,298. MEANS FOR SEPARATING MAGNETIC PARTICLES FROM PAPER PULP; Charles J. Reed, Philadelphia, Pa. App. filed Aug. 15, 1902.

736,319. ELECTRIC COIL; R. Varley, Providence, R. I. App. filed May 2, 1903. An induction coil having a cylindrical sleeve which enters an annular groove in the head of the coil, a space between the sleeve and the outer layer of the coil being filled with wax, which is poured in while in a molten state to render the whole coil waterproof.

736,331. APPARATUS FOR THE GENERATION AND APPLICATION OF ELECTRIC CURRENTS FOR ELECTROLYSIS; Francis Edward Elmore, London, England. App. filed Jan. 2, 1903. (See page 303.)